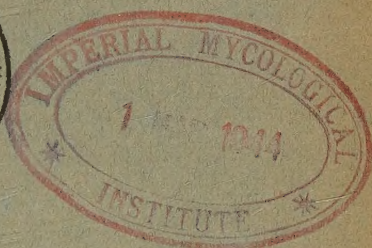


THE
Tea Research Institute
OF
Ceylon

BULLETIN No. 24

Annual Report for the Year
1942.



Published by
THE TEA RESEARCH INSTITUTE OF CEYLON,
ST. COOMBS, TALAWAKELLE,

The Tea Research Institute of Ceylon.

SCIENTIFIC STAFF.

Director

... Roland V. Norris, D.Sc. (Lond.),
M.Sc. (Manc.), F.I.C.

Department of Mycology.

Mycologist ... C. H. Gadd, D.Sc. (Birm.)
Assistant Mycologist ... T. E. T. Bond, Ph.D. (Cantab), M.Sc.
Assistant ... C. A. Loos. (Reading).

Department of Agricultural Chemistry.

Agricultural Chemist ... T. Eden, D.Sc. (Manc.), A.I.C.
Research Assistant ... J. G. Shrikhande, Ph.D. (Lond.)
M.Sc. (Nagpur), A.I.C.
Assistant ... E. N. Perera
Field Assistants ... M. Piyasena
... F. P. Jayawardana

Department of Biochemistry.

Biochemist ... J. Lamb, M.Sc. (Lond.) A.I.C., A.I.C.T.A
[on military service]
Research Assistant ... H. B. Sreerangachar, M.Sc. (Bombay),
B.Sc. (Mysore), A.I.C., A.I.I.Sc.
Assistants ... V. Mendis
... E. L. Keegel
... P. R. Perera

Department of Entomology.

Entomologist ... C. B. Redman King, M.A. (Cantab.), M.C.
Assistant Entomologist ... G. D. Austin [on military service]
Assistant ... D. J. William
Field Assistant ... W. T. Fonseka

Department of Plant Physiology.

Plant Physiologist ... F. R. Tubbs, Ph.D. (Lond.), D.I.C., A.R.C.S.,
F.L.S. [on military service]
Voluntary Worker ... Mrs. T. E. T. Bond, M.Sc. (Reading)
Assistant ... M. H. E. Koch
Field Assistant ... F. H. Kehl

Small-Holdings Officers.

... R. I. Illankoon [on military service]
... M. B. Boange (Acting)
... F. D. Tillekeratne

Superintendent, St. Coombs Estate ... J. A. Rogers

NOTE.

The Laboratories of the Institute are situated at St. Coombs Estate, Talawakelle, and letters and enquiries should be addressed to the Director, Tea Research Institute of Ceylon, St. Coombs, Talawakelle. Telegraphic Address:—Research, Talawakelle; Telephone, Talawakelle 44 (Private Exchange). It is particularly requested that letters should not be addressed to officers by name

SEVENTEENTH ANNUAL REPORT

OF THE

BOARD OF THE TEA RESEARCH

INSTITUTE OF CEYLON

Foundation.—The Tea Research Institute was established by Ordinance No. 12 of 1925, dated the 27th October, 1925. The Constitution of the Board is laid down in that Ordinance, the personnel on the 1st day of January, 1942, being :—

Ex-Officio Members.

The Hon'ble the Financial Secretary (Hon'ble Mr. H. J. Huxham).
The Director of Agriculture (Mr. E. Rodrigo, C.C.S.)
The Chairman, Planters' Association of Ceylon (Mr. D. E. Hamilton).
The Chairman, Ceylon Estates Proprietary Association (Mr. C. H. Bois).

Representatives of the Planters' Association of Ceylon.

Mr. R. G. Coombe.
Mr. J. D. Hoare.
Mr. James Forbes (on leave) Mr. G. K. Newton (Acting).

Representatives of the Ceylon Estates Proprietary Association.

Major J. W. Oldfield, C.M.G., O.B.E., M.C.
Mr. J. C. Kelly.
Mr. W. H. Gourlay,

Representative of the Low-Country Products Association.

Mr. W. P. H. Dias.

Representative of the Small-Holders.

Mr. T. B. Panabokke, First Adigar (Chairman).

Chairman.—Mr. T. B. Panabokke, First Adigar.

Secretary.—Dr. Roland V. Norris.

Solicitors.—Messrs. Julius & Creasy.

Auditors.—Messrs. Ford, Rhodes, Thornton & Co.

Registered Office.—The Victoria Commemoration Building, Kandy.

Mr. D. E. Hamilton ceased to be a Member of the Board on resigning the Chair of the Planters' Association and was succeeded by Mr. N. H. W. Dulling, the new Chairman, on the 17th July.

Mr. R. Mann, on taking over the Chair of the Ceylon Estates Proprietary Association, succeeded Mr. C. H. Bois as a member of the Board with effect from 26th August.

Mr. J. D. Hoare resigned his seat on the Board as from 31st December, 1942.

Cordial thanks are due to Mr. Hamilton, Mr. Bois and Mr. Hoare for the great interest they took in the affairs of the Institute during their term of office on the Board.

Four meetings of the Board were held during the year, the average attendance being eight.

COMMITTEES.

Finance Sub-Committee.—The Chairman, T. R. I.; the Chairman, Planters' Association of Ceylon; the Chairman, Ceylon Estates Proprietary Association; Major J. W. Oldfield, C.M.G., O.B.E., M.C.; Mr. J. D. Hoare, Mr. J. C. Kelly and the Director, T. R. I.

This Committee held two meetings during the year.

Estate and Experimental Sub-Committee.—The Director, T. R. I. (Chairman); the Chairman, T. R. I.; the Visiting Agent (Mr. H. Tonks); the Superintendent, St. Coombs; Messrs. R. G. Coombe, D. T. Richards, R. H. Horne, W. J. Craig, F. J. Whitehead, G. K. Newton and Dr. T. Eden (Convener).

Mr. E. de la Mare was nominated by the Board to fill the vacancy caused by the departure of Mr. F. J. Whitehead from Ceylon. Unstinted thanks are due to Mr. Whitehead for the invaluable assistance he gave to the Institute during his long term of service on this Committee.

Medical Scheme Sub-Committee.—The Chairman, T. R. I.; the Director, T. R. I., and Mr. G. D. Austin (representing the Junior Staff).

Trustees of the Junior Staff Provident Fund.—The Chairman, T. R. I.; the Director, T. R. I.; Mr. R. G. Coombe and Mr. E. N. Perera (representing the Junior Staff).

Visiting Agent.—Mr. H. Tonks continued to act as Visiting Agent and paid three visits of inspection to St. Coombs during the year. The thanks of the Board are due to him for his valuable advice.

FINANCE.

The total receipts amounted to Rs. 428,260, made up as follows:—Cess Rs. 373,054, Profit on St. Coombs Estate Working Account Rs. 49,234 and Miscellaneous Receipts Rs. 5,972. Receipts were thus Rs. 9,949 higher than in 1940. This result was chiefly due to an increased yield from the cess due to restriction being abolished.

Expenditure on Revenue Account, comprising Research Revenue Expenditure at Rs. 237,786, Interest charges on the Government Loan Rs. 35,156, and Depreciation at Rs. 40,185, amounted to Rs. 313,127 as against Rs. 311,578 in 1941. There was thus a surplus on Revenue Account of Rs. 115,132, the corresponding figure for 1940 being Rs. 106,733.

Capital expenditure was incurred to the extent of Rs. 56,043, this sum comprising expenditure on assets of Rs. 16,428 and Rs. 39,615 representing repayment of the Government Loan. Of the expenditure on assets, Rs. 15,751 was on Estate account and Rs. 677 on Research account.

Nett liquid assets as at 31st December, 1942, after allowing for specific liabilities such as the accrued interest on the Government Loan and Furlough and Passages Reserve, amounted to Rs. 442,470. The liability under the Depreciation Reserve at the same date was Rs. 479,021 while the balance due to Government on Loan Account was Rs. 609,495.

ST. COOMBS ESTATE

Weather was on the whole favourable to crop which was a record one for St. Coombs of 212,801 lbs. (exclusive of Broken Mixed, 510 lbs.) The yield per acre on the old tea was 785 lbs., while the 1937 clearing which was lightly plucked gave 271 lbs. per acre.

182,462 lbs. of the crop were sold to the Ministry of Food realising 90.64 cents per lb. nett, while 30,330 sold on the Colombo market realising Rs. 1-20 nett. The average price obtained for the whole crop was 96.47 cents gross or 94.75 cents nett.

Cost of production on revenue account was 72.35 cents as against 59.34 cents in 1941 and an estimate of 67.41 cents. Dearness Allowance accounted for 8.83 cents and loss on rice and other foodstuffs for 2.03 cents of production costs.

Attempts to produce foodstuffs on St. Coombs, whether in pruned areas of the mature tea or in the clearings, were an almost entire failure. Climatic conditions in Dimbula, particularly in the South West monsoon, are too severe to make this a reasonable proposition. Heavy loss was also caused by theft.

The profit on working account amounted to Rs. 49,234, or Rs. 186 per acre, as against Rs. 79,970 and Rs. 302 for the previous year. The lower return was of course due to the increased cost of production as indicated above and the fact that a much smaller proportion of the crop was sold on the Colombo market.

PUBLICATIONS.

Owing to shortage of staff and pressure of other work only two parts of *The Tea Quarterly* could be issued in 1942. Bulletin No. 23, Annual Report for 1941, was also published.

Subscriptions for publications amounted to Rs. 3,247 and receipts from advertisements brought in Rs. 1,386.

Receipts from subscriptions were reduced owing to subscribers in the Far East being unable to receive the publications.

ACKNOWLEDGMENTS.

Cordial thanks are due to the Ceylon Association in London who kindly agreed to make certain security arrangements in connection with the Institute's funds and records. The usual cordial co-operation has continued with the Planters' Association of Ceylon, the Ceylon Estates Proprietary Association and other bodies concerned in the Tea Industry.

Thanks are also due to the Ceylon Chamber of Commerce, Colombo, for the use of their Committee Room for Meetings of the Board held in Colombo.

The Audited Statements of Accounts and the Balance Sheet for 1942 are attached together with the reports of the Visiting Agent and of the Director and Scientific Staff dealing with the research activities of the Institute.

ROLAND V. NORRIS,
Secretary.

THE TEA RESEARCH INSTITUTE OF CEYLON

BALANCE SHEET AS AT 31st DECEMBER, 1942

LIABILITIES

CREDITORS & CREDIT BALANCES :—

Accrued Interest on Loan	...	Rs.	Cts.
Sundry Creditors—Research	...	8,380	57
Sundry Creditors—Estate	...	4,959	54
Subscriptions for Publications	...	16,035	54
received in advance	...	22	32
Contribution for Upkeep of Kowlahena Road received in advance	...	301	00

FURLOUGH RESERVE :—

At 31st December, 1941	...	Rs.	Cts.
Additions during 1942	...	11,293	70
	...	12,172	00
	...	23,465	70
	...	12,597	74

Deduct : Payments during 1942 ...

DEPRECIATION RESERVE :—

At 31st December, 1942	...	Rs.	Cts.
Credited at 31st December, 1942	...	438,835	93
	...	40,185	37

ASSETS

DEBTORS & DEBIT BALANCES :—

Principal Collector of Customs	...	Rs.	Cts.
Refund of Mr. F. P. Jayewardene's Salary by M. O. Dept. for December, (Lost in post)	...	30,230	58
Interest on £2,063.18.1.4%	...	126	04
Funding Stock £41.5.6	...	549	37
Interest on £2,300.0.0.3½%	...	531	14
War Loan £40.5.0	...	660	00
By amount received from the Fertiliser Control Bureau A/c. Stationery, Postages, Clerical Work etc.,	...	32,097	13

SUNDRIES—RESEARCH :—

Ceylon Association in London	...	Rs.	Cts.
£6,766.12.1	...	90,221	39
Research Staff	...	1,384	02
Suspense Account	...	20	00
Accrued Interest on Fixed Deposits	...	900	79
	...	92,526	20
	...	813	56

SUNDRIES—ESTATE

STOCKS-IN-HAND

Tea 32,158 lbs.	...	Rs.	Cts.
Stock	...	30,426	41
Rice	...	12,305	64
Kurakkan	...	1,303	92
Paddy	...	4,600	85
Wheat	...	1,397	44
Flour	...	36	19
Green Peas	...	44	21
Gram	...	2,942	21
	...	4,270	56

Carried over Rs. 519,588.23

Carried over

Rs. 182,764.32

THE TEA RESEARCH INSTITUTE OF CEYLON

BALANCE SHEET AS AT 31st DECEMBER, 1942—(contd.)

LIABILITIES

	Rs. Cts.		Rs. Cts.
Brought forward	Rs. 519,588.23	ASSETS	
		Brought forward	Rs. Cts.
			182,764.32
		INVESTMENTS	
		£2,300-0-0 3½% War Loan	32,464.76
		£2,063-18-1 4½% Funding Stock	29,928.06
		Rs. 30,000/- 3½% Ceylon Govt. Loan 1957/62	29,512.50
		Rs. 15,000/- 3% " Defence Bonds	15,000.00
		Rs. 20,000/- 3% " "	20,000.00
		CASH:—	
		Fixed Deposit	80,091.08
		Current Account	82,022.78
		N. B. I. Ltd., N'Elhiya	1,854.92
		In hand	2,289.94
			Rs. Cts. 166,258.72
		Estate—N.B.I. Ltd. Colombo,	7,861.97
		" In hand	34.08
			7,896.05
		FUNDS OVERSPENT	
		To 31st December, 1941	94,883.21
		Capital Expenditure, 1942	16,428.15
		Repayment of Govt. Loan 1942	39,614.65
			150,926.01
		Less: Revenue applied for Capital purposes, being Revenue Account Surplus for the year 1942	115,132.19
			35,793.82
			Rs. 519,588.23

We have audited the books of the Tea Research Institute of Ceylon and have obtained all the information and explanations required by us. The allocations of Capital Expenditure and of Research Revenue Expenditure as made by the Director have been accepted by us.

We are not in a position to say whether the Reserves made for Depreciation are adequate.

Subject to the foregoing reservations the above Balance Sheet, in our opinion, is properly drawn up so as to exhibit a true and correct view of the financial affairs of the Institute at 31st December, 1942, according to the best of our information and the explanations given to us, and as shown by the books.

• (Sgd.) FORD, RHODES, THORNTON & CO.,

Colombo.

Chartered Accountants

THE TEA RESEARCH INSTITUTE OF CEYLON

CAPITAL ACCOUNT AS AT 31st DECEMBER, 1942

EXPENDITURE

	To 31-12-41	Additions in 1942	Total
	Rs. Cts.	Rs. Cts.	Rs. Cts.
To LAND, INCLUDING DEVELOPMENT	867,784 62	12,892 50	880,677 12
„ BUILDINGS AND LINES	942,691 43	2,658 26	945,349 69
„ FURNITURE AND EQUIPMENT	81,924 82	514 48	82,439 30
„ LABORATORY EQUIPMENT	42,623 38	162 91	42,786 29
„ EXPERIMENTAL MACHINERY	29,705 38	—	29,705 38
„ MACHINERY—ESTATE	131,381 37	200 00	131,581 37
„ MOTOR ROAD ROLLER	7,386 03	—	7,386 03
„ MOTOR CAR	4,025 00	—	4,025 00

Rs. 2,107,522-03 16,428-15 2,123,950-18

St. Coombs.

RECEIPTS

	Rs. Cts.	Rs. Cts.
By GOVERNMENT OF CEYLON:—		
Loan on Mortgage @ 5½% per annum	1,000,000-00	
Less: Repayments to 1942	390,504 23	609,495 77
„ REVENUE APPLIED TO CAPITAL PURPOSES TO 31-12-41	1,363,528 40	
do „ 31-12-42	115,132 19	1,478,660 59
„ FUNDS OVERSPENT TO 31-12-41	94,883 21	
Less: 1942 underspent	59,089 39	35,793 82

Rs. 2,123,950-18

(Sgd.) ROLAND V. NORRIS,

Director.

THE TEA RESEARCH INSTITUTE OF CEYLON

LOAN ACCOUNT

To GOVERNMENT OF CEYLON LOAN A/c.	Rs. Cts.	Rs. Cts.	By REPAYMENTS PRINCIPAL to 31st December, 1941	...	Rs. Cts.
	Rs. 1,000,000-00			...	350,889-58
			" To 31st December, 1942	...	39,614-65
			" Balance	...	609,495-77
	<u>Rs. 1,000,000-00</u>				<u>Rs. 1,000,000-00</u>

ROLAND V. NORRIS,
Director

THE TEA RESEARCH INSTITUTE OF CEYLON

ESTATE WORKING ACCOUNT AS AT 31st DECEMBER, 1942					
EXPENDITURE			R ^s . Cts.	INCOME	
To	Estate Expenditure—Revenue	...	153,964-39	By Tea Sales—Colombo	30,330 lbs.
"	Charges to Invoice No. 24	...	5,786-61	Do —Tea Commissioner	182,462 "
"	Balance Carried Forward	...	49,233-92	Do —Local	487 "
				Do —Broken Mixed	6,036 "
				Do —Biochemical Dept.	32 "
				Do B. M.	18 "
				MOTOR ROAD ROLLER ACCOUNT	...
					Rs. Cts.
					38,257-34
					169,253-42
					354-32
					1,010-69
					34-06
					75-09

Rs. 208,984.92

THE TEA RESEARCH INSTITUTE OF CEYLON

REVENUE ACCOUNT AS AT 31st DECEMBER, 1942—(Contd.)

	Rs.	Cts.	Rs.	Cts.	Rs.	Cts.
					Brought forward	
					Rs. 428,259-60	
To PERSONAL EMOLUMENTS OF						
SCIENTIFIC STAFF :—						
Director	22,500-00					
Mycologist	20,250-00					
Agricultural Chemist	19,500-00					
Entomologist	12,018-06					
Plant Physiologist	7,876-65					
Biochemist	7,932-35					
Asst. Mycologist	10,137-50					
					100,214-56	
Brought forward					13,693-31	
SUB-SCIENTIFIC STAFF :—						
Junior Scientific Staff	42,561-94					
Lab. Attendants & Fieldman	5,754-77					
					48,316-71	
LABORATORY :—						
Equipment and General Working Expenses	2,808-48					
Special Provision for Joint Research on Chemistry of Tea	5,022-48					
Furniture and Office Equipment	—					
					7,830-96	
LIBRARY AND PUBLICATIONS :—						
Library	1,678-77					
Publications	Cr. 1,920-74					
					Cr. 241-97	
SMALL-HOLDINGS :—						
Salaries and House Allowances	5,551-32					
Travelling and General Expenditure	1,904-44					
					7,455-76	
Carried over	Rs. 177,269-33					
Carried over					Rs. 428,259-60	

THE TEA RESEARCH INSTITUTE OF CEYLON

BULLETIN No. 24

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REVENUE ACCOUNT AS AT 31st DECEMBER, 1942—(Contd.)

	Rs.	Cts.	Rs.	Cts.	Rs.	Cts.
					Brought forward	+28,259·60
" FIELD AND FACTORY EXPERIMENTS :—						
Agricultural Chemist	3,419	47				
Plant Physiologist	311	60				
Miscellaneous Field Experiments	218	80				
Factory Experiments	1,506	84	5,456	71		
" TRAVELLING OF STAFF :—						
Officers' Expenses	1,818	48				
Insurance of Car and Licence	148	67				
Drivers' Wages	1,529	25				
Drivers' Batta	236	35				
Running Expenses and Repairs...	1,615	80	5,348	55		
" MAINTENANCE OF BUILDINGS :—						
Laboratory	16	95				
6 Senior Staff Bungalows	717	00				
13 Junior Staff Bungalows	1,089	35				
3 Clerks' Bungalows	225	00				
Miscellaneous Lines and Buildings	1,441	81				
Passara Buildings	8	40				
Rest House	—	—				
Replacements and Renewals—Junior and Clerical Staffs Furniture	696	68	4,195	19		
" GENERAL SERVICES :—						
Electric Power	5,451	30				
Mechanic	1,107	30				
Telephone Rent and Maintenance of Lines	595	70				
Roads	593	00				
Sanitation	1,222	14				
Water Supply	1,841	06				
Tappal Lorry and Book Fees	264	00				
Nettikans & Drains	218	00				
Upkeep of Grounds	944	32				
Rest House	710	65	12,947	47		
Carried over	205,217	25			Carried over	428,459·60

THE TEA RESEARCH INSTITUTE OF CEYLON

REVENUE ACCOUNT AS AT 31st DECEMBER, 1942—(Contd.)

	Rs.	Cts.	Rs.	Cts.	Rs.	Cts.
To MISCELLANEOUS:—						
Incidentals	...	175-87				
Provident Fund, Senior Sc. Staff	...	12,026-79				
Do Junior Scientific Staff	...	5,014-43				
Do Sub-Staff	...	1,443-50				
Passages	...	6,000-00				
Ceylon Nursing Association and Fraser Nursing Home	...	135-00				
Medical Fees Sub-Staff	...	204-31				
Medical Scheme Junior Staff	...	1,245-00				
Insurances	...	3,441-72				
Watchmen and Caretakers	...	641-86				
Conference Expenses	...	—				
Observatory Allowance	...	240-00			30,568-48	
„ GOVERNMENT OF CEYLON LOAN INTEREST ACCOUNT	...				35,156-31	
„ DEPRECIATION	...				40,185-37	
„ LOSS ON REDEMPTION	...				2,000-00	
„ Balance	...				115,132-19	
					<u>Rs. 428,259-60</u>	
						<u>Rs. 428,259-60</u>

ROLAND V. NORRIS,
Director.

REPORT

ON

ST. COOMBS ESTATE

FOR 1942

The following short report is specially written on the working of St. Coombs Estate for 1942, for inclusion in the Tea Research Institute's Annual Report for that year, and it is in addition to the usual Visiting Agent's reports on the property.

Superintendent.—Mr. J. A. Rogers.

ACREAGE.

			A.	R.	P.
Tea in Bearing	...	...	264	1	06
Tea New Clearings 1937	...	...	20	0	00
Tea New Clearings 1938	...	...	16	0	00
Nurseries	...	...	1	1	08
Fuel Clearings	...	...	33	0	00
Reserve available for planting	...	...	27	1	09
Waste Land, Swamps, etc.	...	...	26	1	14
Total ...			414	3	19

Weather.—Rainfall registered at factory in 1942—104.32 ins. on 249 days.
Rainfall registered at factory in 1941—113.96 ins. on 269 days.

There was no real drought in the early months of 1942 and weather for the first half-year was favourable for crop. The S. W. Monsoon set in on 24th May and was prolonged till mid-October, during which time little sunshine was recorded. The N. E. Monsoon more or less failed, the usual afternoon showers and forcing weather being absent.

Crop.—Total crop harvested in 1942—212,801* lbs.—Estimate 190,000 lbs.
Total crop harvested in 1941—203,573 lbs.—Estimate 185,000 lbs.

The further increase in crop in 1942 is most satisfactory, and constitutes a new record crop.

Yield per acre—1942 (old tea)—785 lbs. on 264 acres.

Yield per acre—1941 (old tea)—771 lbs. on 264 acres.

Three fields yielded over 1,000 lbs. per acre in 1942, the highest yield being 1,225 lbs. from No. 8.

* exclusive of 510 lbs. Broken Mixed sold in Colombo.

The 1937 Clearings (20 acres) were lightly plucked in 1942, and gave a combined yield of 271 lbs. per acre.

Prices.

			Gross Average per lb.	Nett Average per lb.
1942	...	213,311 lbs.*	97.47 cents	94.75 cents
1941	...	203,573 lbs.**	Rs. 1-01.7 cents	98.27 cents

182,462 lbs. were sold on contract to the Minister for Food, London, realizing 90.64 cents per pound nett.

30,330 lbs. were sold on the Colombo Market, realizing Rs. 1-20 per pound nett.

212,792 lbs. at 94.79 cents per pound nett, sold on contract and in Colombo.

Profit on Estate's Working.

1942—Rs. 49,234 equivalent to Rs. 186 per acre on 264 acres.

1941—Rs. 79,970 equivalent to Rs. 302 per acre on 264 acres.

Cost of Production (Revenue Account).

1942—72.35 cents per lb.—Estimate 67.41 cents per lb.

1941—59.34 cents per lb.—Estimate 64.34 cents per lb.

It is noted that in 1942 'Proportion of General Charges' amounts to 30.17 cents per pound, which is a very high figure as compared with ordinary estate costs, owing to the unique circumstances of St. Coombs Estate. It includes:—

Dearness Allowance to Labourers	...	7.95 cents
Dearness Allowance to Subordinate Staff	...	.88 cents
Loss on Rice and other Foodstuffs	...	2.03 cents
Total	...	<u>10.86 cents</u>

Capital Expenditure.

1942—Rs. 15,751 or 7.40 cents per lb.—Estimate Rs. 16,927 or 8.90 cents per lb.

1941—Rs. 47,932 or 23.54 cents per lb.—Estimate Rs. 48,987 or 26.48 cents per lb.

1942—Total Cost of Production (Revenue and Capital) 79.75 cents

1942—Total Cost of Production (Estimate) 76.31 cents

CULTIVATION.

Manuring.—Owing to lack of transport for artificial manure only 122½ acres were manured, instead of the 299½ acres estimated, and the majority of this acreage received a considerably reduced dose. The average application was 29.2 pounds nitrogen per acre.

Owing to the voluntary rationing of artificials, the manuring programme has been revised. The quota for 1943 under the Fertiliser Rationing Scheme is 58 tons of the Standard Tea Mixture, or 26 lbs. nitrogen per acre per annum.

* inclusive of 510 lbs. Broken Mixed sold in Colombo, and Local Sales.

** exclusive of Broken Mixed.

Pruning.—The programme was completed at a cost of Rs. 17-60 per acre. The improvement in the growth of new wood, and the spread of the bushes, continues. With manuring reduced to about 50 per cent the question of reducing the four-year pruning cycle will come up for consideration.

Green Manuring.—The forking in of leaf-fall after pruning continues, and large quantities are incorporated into the soil. All available green manure, augmented by Wild Sunflower loppings from ravines, is forked in with applications of artificials.

Supplying.—A start was again made in supplying vacancies, etc. in Old Tea.

Weeding.—The whole acreage is gang weeded on Estate Account largely by children, *without* the use of scrapers, resulting in a minimum loss of top soil. Weeds were troublesome particularly in the S. W. Monsoon months, but were kept well under control, though the cost was Rs. 2-16 per acre, an increase of 17½ per cent over the cost for 1941.

New Clearings.—1937—20 acres.

1938—16 acres.

The 1937 Clearings were lightly plucked in 1942 and yielded 271 lbs per acre. The 1938 Clearing is making useful growth now that the root system is getting well down into the sub-soil.

Both clearings were supplied, and received an application of artificials at the rate of one ounce per bush.

Labour.—At the end of 1942 there were 373 working labourers on the estate, which are equivalent to 1.32 labourers per acre in full bearing. There was extremely little movement within the Island, but during 1942 31 labourers went to India, 13 old ones returned, and 16 children were taken on the register.

The out-turn of labour has been good, but there is a tendency to decrease the daily task.

Lines.—There are 148 Line Rooms up to Government Standard.

Factory and Machinery.—The factory building is in excellent order, and well maintained. Machinery is in good order and well kept. The Moore's Chota Sifter, estimated for 1942, was not delivered and installed until 1943.

Food Production.—The requirements of this estate were carried out chiefly by "interplanting" in Old Tea and in the New Clearings, and resulted in almost complete failure both in the Yala and Maha seasons, and any crop that did grow was shamelessly stolen before it matured.

General.—The general improvement in the appearance, spread and vigour of the tea has so far been maintained and in spite of shortage in supplies of artificials during 1942 a new record crop was harvested, which was very satisfactory.

Mr. Rogers is to be congratulated on a successful year in the more difficult circumstances which now exist.

HUBERT TONKS,
Visiting Agent.

REPORT

OF

THE DIRECTOR,

TEA RESEARCH INSTITUTE OF CEYLON

FOR 1942

This report is this year issued in a condensed form; in particular, no detailed summary is given in this section of the report of the technical work of the various Departments of which readers will find full details in the reports of individual officers.

Finance.—Receipts were higher owing to increased exports of tea, and the surplus on revenue account was Rs. 115,132 as against Rs. 106,733 in 1941. Full details of receipts and expenditure will be found in the Report of the Board and the audited accounts published earlier in this report.

St. Coombs Estate.—Full details of the year's working are given in the Report of the Visiting Agent (*vide ante*). Labour conditions remained settled and no trouble occurred amongst the labour force during the year.

Food Production.—The trials in regard to food production on St. Coombs, and the knowledge gained in the course of the advisory work of the staff of similar efforts on other estates, have provided experience which may render necessary a considerable change of policy both on St. Coombs and estates working under similar conditions.

In the past four years the Tea Research Institute has experimented with land in three different stages of cultivation, viz. (1) freshly opened patna, (2) patna opened in tea with five years' cultivation of the type usually provided for this crop and (3) land which has been under mature tea for a long period of years.

With regard to (1) our practical experience, coupled with previous knowledge of the average soil conditions encountered on such lands, made it clear that, for *immediate* results, freshly opened patna was quite unsuitable, except perhaps in sheltered positions with a good soil depth, e.g. in specially selected deniyas.

Conditions prevailing in example (2) were little better because, though cultivation was better, improvement in soil conditions, which could only be gained by adequate manuring and incorporation of green manures, had not made sufficient progress. In short, what would suffice to establish a young perennial crop such as tea would not produce a quick-growing short term annual one.

Example (3) whilst promising initially better growth than the other conditions was eventually marred by the over-riding factor of weather.

In these circumstances it is considered that so far as St. Coombs is concerned, and the conclusion must unfortunately apply to many other estates under similar conditions of climate and land, a better contribution to the food problem can be made by joining an approved undertaking in a zone offering better facilities in respect of both soil and climate.

Everyone will appreciate the paramount importance of growing food wherever this can be done with a reasonable amount of success, and it is essential that every estate where conditions are even moderately suitable should continue its food production efforts. On the other hand a realistic attitude must be adopted; what is required is food and food in the immediate future, and where local climatic or soil conditions are such as to render the production of such food a precarious gamble with all the odds against success, then surely it must be sound policy to concentrate available funds, energy and labour on the development of land in areas more fortunately situated. Most estates have now sufficient experience to be able to estimate what are the prospects of success on their own land and future policy should be directed by such experience.

Many estates which cannot produce grain crops may be able to obtain profitable crops of roots and, where this is the case, it will be advantageous to grow them to the limit of current requirements. At elevations above about 3,000 feet, particularly in zones subject to heavy S. W. monsoon conditions, even this type of food production has given exceedingly erratic and, on the whole, disappointing results; in the interests of maximum food production it is suggested that in such areas the most satisfactory solution may well be to join in syndicates operating at lower elevations.

The Staff of the Institute have in conjunction with the Staff of the other Research Institutes and the Department of Agriculture acted in an advisory capacity to estates in their areas in regard to food production.

Staff.—Lieut.-Colonel F. R. Tubbs (Plant Physiologist), Pilot Officer C. B. Redman King (Entomologist), Captain J. Lamb (Biochemist) and Capt. R. L. Illankoon (Small-Holdings Officer) were on military duty throughout the year. The Institute was fortunate, however, in having the voluntary services of Mrs. J. Bond, M.Sc., who has given most valuable assistance in regard to the work on tea selection and propagation. The Director, in addition to his own duties, has been in direct charge of the Biochemical Division and in September, at the request of the Planters' Association of Ceylon and the Ceylon Estates Proprietary Association, undertook the organisation of a voluntary scheme of fertiliser rationing and distribution to estates. This latter work has absorbed most of his time since that date and is referred to later. He was also appointed a member of the Co-ordinating Advisory Committee set up at the request of the Minister for Agriculture and Lands to act as an Advisory Committee to the Director of Agriculture in regard to food production work on estates. In this connection he and the other members of the Senior Staff acted as Advisory Officers on food production to estates, both tea and rubber, in the following areas: Uva, Nuwara Eliya, Dimbula, Dickoya, Dolosbage-Kotmale, Pussellawa and Balangoda. Advisory work in other areas was divided between the Department of Agriculture and the Rubber and Coconut Research Schemes.

The Director was also appointed a member of the Advisory Committee of the Chemical Society of Ceylon to which Government Departments may apply for technical advice on matters arising out of the war.

Dr. Gadd in addition to his own duties has been in charge of the Entomological Division and, with the assistance of Mrs. Bond, of the Physiological Section.

Dr. Eden has continued in charge of Field Experiments. He has also served as technical adviser to the Planters' Association in regard to matters concerned with the computation of the Dearness Allowances now payable to estate labourers. As a result of his recommendations this has now been placed on a more satisfactory basis.

In the middle of the year Mr. M. B. Boange was appointed Acting Small-Holdings Officer in the Gampola area.

Fertiliser Rationing and Distribution.—In view of the serious position which arose during the year in regard to fertiliser supplies and distribution, a scheme of voluntary rationing was organised by the Director in September last and a plan of distribution worked out to ensure that all estates received an equitable share of the stocks available. An essential part of the scheme is that it is not confined to the Planters' Association and Ceylon Estates Proprietary Association members, all those normally requiring manure for tea or rubber cultivation being able to utilise the organisation set up to obtain their quotas of manure by means of regular quarterly distributions. Coconut estates are not rationed but their consumption of manure is small. Details of the scheme will be found in the *Tea Quarterly*, 1943, Part 1. Restriction of fertiliser supplies has naturally fallen chiefly on the tea industry as the allocation of manure to rubber estates provides the full quota of nitrogen considered necessary by the Rubber Research Scheme for full production to be maintained. In the case of tea, however, the rationed level of manuring probably does not represent more than 60 to 65 per cent of normal requirements. There are unfortunately no reliable figures available by which the normal consumption of nitrogenous fertilisers by the tea industry can be gauged. It is probable however that the *average* application of nitrogen per acre before the war was not more than about 35 pounds.

The acreage under the rationing scheme now covers approximately 440,000 acres of tea and 300,000 acres of rubber, including 1,075 tea estates and 950 rubber estates. In addition, manure permits have been issued for some 22,000 acres of estate food production areas. Requirements under the latter head are likely to increase.

Advisory Work.—War conditions and the absence of so many Estate Superintendents on military duty have naturally been reflected in a considerable falling off in the number of enquiries received from estates, while the present restrictions on travel have made it almost impossible for persons from a distance to visit the Institute and have limited the amount of touring that could be carried out by members of the staff.

Publications.—In consequence of the shortage of staff, and the fact that the remaining officers were all carrying additional responsibilities in addition to their normal duties, it was only possible to publish two numbers of the *Tea Quarterly* in 1942. In addition, Bulletin No. 23, Annual Report for 1942, was issued.

Technical.—Readers are referred for full details of the technical work in progress to the reports of the staff which follow. It has for obvious reasons been impossible to adhere to the normal programme of work but it is satisfactory to note that all major experiments and, in particular, field experiments, have been maintained, and, as the reports show, definite advances have been made in many directions. More detailed knowledge is now being obtained in regard to eelworm infection of estates and it must be confessed that the position gives cause for some anxiety. Results are beginning to emerge in regard to the *Phloem necrosis* disease of tea which fortunately still remains chiefly confined to estates at elevations exceeding 4,000 feet. The virus nature of the disease is now experimentally proved and knowledge is accumulating in regard to the relative resistance of high and low “jats” to infection. The opportunity has been taken to review and clarify the large mass of data that has accumulated in regard to shot-hole borer and it seems likely from the facts which have already emerged that our views about this pest may have to be modified in several respects, particularly in regard to the effect of manure.

On the Biochemical side, the nature of the enzyme complex responsible for fermentation has been largely elucidated and it is of interest to note that copper seems to be an essential part of the system.

The rationing of fertilisers has stressed the importance of their most economic utilisation and the Institute's field experiments have given a clear lead in this direction in their indication that applications at the time of pruning when the bushes are largely depleted of leaf are less effective than later and graduated applications. It has also been clearly shown that there is a directly proportional increase in crop with increasing applications of nitrogen, at any rate up to 80 lbs. nitrogen per acre. Unfortunately this is not likely to be of practical importance until after the war!

Work on tea selection and vegetative propagation has been carried out without interruption and 74 clones of selected material have now been put out in the field. The preliminary tests of these have been satisfactory in so much as some of the best manufacturing qualities are combined with high yielders. It remains to be seen whether any of these selections may also possess a higher resistance towards *Phloem necrosis* or eelworm infestation.

Advisory work among small-holdings in the Kadugannawa-Gampola and Baddegama areas has proceeded on the usual lines. The present regulations in regard to tea purchases, and the demand for full production, have naturally resulted in the resumption of plucking on these holdings and efforts have been made to encourage small-holders to produce leaf of a reasonably satisfactory standard.

Acknowledgments.—Our thanks are, as usual, due to the Ceylon Association in London, the Planters' Association of Ceylon and the Ceylon Estates Proprietary Association for their co-operation and support. We are particularly indebted to the Ceylon Association who undertook additional responsibilities in regard to the Institute when conditions in Ceylon became somewhat uncertain in the early part of the year.

Messrs. George Steuart & Co., and the Superintendent, Gonakelle Estate, have continued to afford all necessary assistance at the Passara Sub-Station and Messrs. Leechman & Co. and their Superintendents have given valuable help in the work on *Phloem necrosis*.

Thanks are also due to many other Agency Firms and Superintendents who have assisted in various ways. We are particularly indebted to Messrs. Forbes & Walker in connection with tea shipments and to Mr. R. H. Horne for invaluable help in testing and reporting on experimental samples, particularly teas from the clonal selections. Messrs. C. J. Speer and R. C. Kerr have kindly given similar assistance with experimental samples.

During the year we were unfortunate in losing the assistance of Mr. F. J. Whitehead on his departure from Ceylon. Mr. Whitehead has for many years given us the benefit of his unique experience in regard to tea manufacture and its problems, and the Institute is under a deep debt of gratitude to him for all he did to further the work of the Institute in this direction.

Our cordial thanks are also accorded to Mr. H. Tonks for advice and help given in his capacity as Visiting Agent.

In connection with our small-holdings work we have to acknowledge with thanks the assistance given by the R.M's, Minor Headmen and Village Committees in the areas in question. We are again particularly indebted to the Wanduramba Village Committee for a contribution to the Small Holdings Competition Prizes and to the Chairman of this Committee, Mr. W. Amerasinghe, for his continued interest in our work.

In conclusion, the Director desires to record his personal thanks to all members of his Staff for their support and loyal service throughout a year of heavy work often carried out under difficult conditions.

The Reports of the Scientific Staff are appended.

ROLAND V. NORRIS,

Director.

REPORT

OF

THE MYCOLOGIST

FOR 1942

Staff.—In addition to his own duties the Mycologist remained in charge of the Entomology and Physiology Divisions during the year.

Dr. T. E. T. Bond has continued his Study of the *Phloem necrosis* disease of tea and has been in charge of the herbarium and of the work concerning weeds, cover crops and green manures. His report on *Phloem necrosis* is included here under that heading, and his report on weeds, cover crops, etc. will be found in the report of the Physiologist.

Advisory.—224 letters were received and 213 despatched. 124 consignments of plants were received for examination and report. The decrease in the number of enquiries during the year is to be attributed more to a decrease in supervision of estates resulting from war conditions than to actual decrease in the amount of disease amongst the tea.

Publications.—In addition to articles in the *Tea Quarterly* the following papers have been contributed to other journals:—

Bond, T. E. T.—Studies in the vegetative growth and anatomy of the tea plant (*Camellia thea* Link.) with special reference to the phloem. I The flush shoot. *Annals of Botany*, n.s. VI, pp. 607-630 (1942).

Loos, C. A.—Some virus diseases of *Stachytarpheta*. *Tropical Agriculturist* XCVIII pp. 8-12 (1942).

Gadd, C. H. and Loos, C.A.—Observations on the life-history of the nematode *Panagrolaimus rigidus*. *Spolia Zeylanica* (awaiting publication).

Brown Root Disease.—A somewhat unusual case of Brown Root disease (*Fomes noxius*) has been reported this year. Two years ago a Grevillea tree was pollarded at a height of 16 to 18 feet; two small branches then remained on the tree. No new growth was made after pollarding. This year three tea bushes growing near the Grevillea died and their roots were found to be infected with the fungus of Brown Root disease. The roots of the Grevillea were also infected and there is good reason to believe that the fungus passed from the Grevillea to the tea and not *vice versa*. The infection of tea roots from the roots of felled Grevillea trees is by no means unusual; in fact it is the commonest route by which *F. noxius* reaches tea roots. In this instance the attack on the tea bushes came via the roots of a pollarded Grevillea.

Very few uncut *Grevillea* trees, if any, have been reported to be killed by Brown Root disease, but after apparently healthy trees have been felled it is commonplace for tea bushes in contact with their roots to die of that disease (Tea Research Institute Bulletin No. 17 p. 25). This sequence of events has given rise to the view that the stump of the felled tree becomes infected by spores carried in the air whence the infection spreads to the tea via the stump roots. If that view is correct infection through a large wound 16 to 18 feet above ground is equally possible. The fungus would then have to grow through wood for that additional distance to reach the tea bushes' roots. In this instance only two years elapsed between pollarding and the death of the tea bushes — a rather small interval.

The practice of pollarding *Grevilleas* appears to have increased in recent years in Ceylon. As yet, the above is the first case of Brown Root disease following pollarding to be reported to the Institute, and the Mycologist would be interested to hear of other cases experienced by planters.

ANGUILLULINA PRATENSIS.

Occurrence.—The eelworm *Anguillulina pratensis* has been found attacking tea on 5 more estates during the year, making a total of 13 estates now known to be infested.

Pot Plants.—In February 1942 a number of tea plants two to three years old, growing in 12-inch pots in the laboratory compound, appeared somewhat sickly. In all there were 51 plants with foliage, of which 32 appeared sickly. When removed from the soil, 31 of the sickly plants were found to have few feeding roots; the rootlets of the remaining plants were numerous and the root system appeared normal. Lesions containing *A. pratensis* were found in the taproots of 8 of these plants and it seemed probable that this eelworm was the cause of the trouble. The rootlets of the other sick plants were therefore examined and *A. pratensis* were found in all except five. Examination of the soil from the five pots disclosed the eelworm's presence in 3 of them. *A. pratensis* was thus associated with 30 of the sickly plants, and all but one were deficient of feeding roots.

The 19 healthy looking plants were then examined similarly, and a normal number of feeding roots was found on 17 of them; 2 only had few rootlets. A few eelworms were found in 4 of the 17 plants with many rootlets, and in one of the two plants with few rootlets. Examination of the soils in which the eelworm free plants had grown disclosed its presence in 4 and its absence from 8 of them; two were not examined.

This information is summarised in the following table.

	Number	Rootlets		Eelworms :			
		Many	Few	In roots		In soil	
				+	—	+	—
Sickly plants	32	1	31	27	5	30	2
Apparently healthy plants	19	17	2	5	14*	9	8

* 2 soils were not examined.

The paucity of feeding roots was, no doubt, the main cause of the sickly appearance of the plants. It is known that attack by the eelworm *A. pratensis* causes a large reduction in the number of feeding roots, so it seems fair to assume that the trouble in these pots had been caused by that eelworm. Against such a conclusion is the fact that the same eelworm was found in the rootlets of 5 and in the soil around 9 of the plants passed as healthy. It follows that either the eelworm does not cause the damage attributed to it or that some tea plants are more resistant to attack than others. The latter alternative appears more probable as it is not unusual to find apparently healthy and vigorous bushes among the sickly ones growing in heavily infested soil.

In a Clearing.—The discovery of eelworm in the pot soils raised the important question of their origin. It was known that much of the soil in these pots had been collected from a clearing at St. Coombs in 1939, so attention was directed to that quarter. The general appearance of the young plants in the clearing did not suggest eelworm infestation though one heavily infested plant was found with large lesions on the tap root. A large number of *A. pratensis* was easily obtained from this plant which gave proof that the eelworm was present and active in the clearing.

As the diseased plant was found on the perimeter of a block reserved for experiments which had been planted with stumps from a known nursery, 100 soil samples were taken from the block, and in 34 of them the eelworm was found. The infested soils were distributed at random through the area, and as previously noted, the condition of the plants at the time gave no indication of the infested sites. Attention was then directed to the nursery from which the stumps were obtained. The nursery also proved to be infested and later plantings have not been successful.

It seemed probable, therefore, that the infection of the St. Coombs clearing resulted from the planting of infested stumps. If that were the case, however, one might expect the stumps carrying eelworm at the time of planting to show marked evidence of attack three years later, in 1942. Plants from infested sites, however, bore no eelworm lesions on the tap roots. As all feeding roots are usually removed from stumps before planting, any eelworms invading such roots would also be removed; that leaves infected taproots and adhering soil as the main possible sources of infection.

The possibility that the soil was infested before planting remained to be investigated. The clearing was made from patna land in 1937 and as small areas of similar land remained uncultivated in the vicinity, soil samples were taken from these. Of 44 samples examined 29 have been found to contain *A. pratensis*. It seems probable therefore that the main area was also infected at the time it was opened. It is, however, a curious coincidence that a nursery supplying plants for the area should also prove to be infested.

These observations suggest that the natural habitat of this eelworm is grassland, which justifies its specific name *pratensis*. Further investigations are necessary to determine to what extent patna land is normally infested in Ceylon. Many tea fields have been made satisfactorily from patna land and without this eelworm causing damage to the tea. Many fields on St. Coombs were originally patna, but so far one field only is known to be infested.

Effect of Flooding.—In the laboratory, *A. pratensis* when left in water usually dies within a few days unless the water is well aerated. This fact suggests that soils may be freed from the pest by water logging where such treatment is possible. It was found possible to flood a few beds of a tea nursery known to contain *A. pratensis* in August. The soil was forked and stirred before flooding, and soil samples were taken from time to time. Not until December could the water-logged soil be reported as free of that eelworm. Other species survived the treatment, and other beds which had lain fallow after forking remained infested at the end of the year.

Other Nematodes.—During the year about 500 soil samples have been examined for nematodes. Mr. Loos has collected from these approximately 70 different species about which little is known. Available literature on the subject is very limited in Ceylon, and identification of the great majority of species has been found impossible. Despite these handicaps it is considered advisable to continue this work as opportunity permits and later to seek the aid of specialists in solving some of the problems.

PHLOEM NECROSIS.

An important advance has been made this year in that the experimental demonstration of the virus nature of *Phloem necrosis*, as afforded by successful graft transmission of the disease, can now be regarded as complete. Further valuable confirmatory evidence continues to be given by the field observations. Entomological investigations are still in a preliminary stage and have been confined to the brown scale insect (*Saissetia coffeae*). Research on the anatomy and periodicity of growth of healthy tea has been continued and provides a background to the study of necrotic material. In the virtual absence of advisory enquiries dealing with *Phloem necrosis* during the year, the report which follows is confined to the experimental aspects of the subject.

Grafting Experiments.—Four types of grafts are in use, namely, root grafts, "couple grafts," seedling grafts, and inarches. These terms have been explained in the last two Annual Reports on *Phloem necrosis* (Tea Research Institute Bulletins 22, p. 41 and 23, pp. 38-9).

Root grafts were made originally between November 1940 and February 1941 and by the end of the latter year these plants were showing indications of transmission of *Phloem necrosis* to certain low jat scions. These indications have now been fully confirmed, the necrosis having been recorded during 1942 in all of the thirteen surviving low jat grafts and in three only out of eleven high jat grafts. Furthermore the low jat grafts have now developed unmistakable external symptoms of the disease so that the diagnosis in these plants may be regarded as complete. A possible transmission was also recorded in two plants of a batch made in January, 1942, i.e. within a year of grafting but the survival rate of this and of a second lot made in May has been disappointingly low, very heavy losses having been experienced while the grafts were still in the propagating boxes. Certain modifications of the grafting procedure will be tried out next year.

The most successful transmission results have been obtained by the "couple grafting" method. This was used first during 1941 for grafting to mature bushes in the field, and indications of transmission to certain scions were obtained from the plants, again within about a year of

grafting. However, the second lot of grafts, made in April, 1942, has been better. These were made with *low jat* scions, grafted on to some old seedling grafts, planted out in beds. The latter had shown no indications of transmission in three of four years. They consisted of a *high jat* seedling stock grafted with a necrotic scion and the continued persistence of necrotic symptoms in these scions, growing on apparently healthy root systems, was commented upon in the last Annual Report (Tea Research Institute Bulletin 23, p. 41) as strongly in favour of the hypothesis of the virus origin of the disease. These old grafts were trimmed down and the new scions grafted to both stock and scion components. The new grafts took well and, in each case, produced shoots in which symptoms of the necrosis rapidly developed. There was no difference in behaviour between the scions grafted on to the, apparently, healthy stocks and those grafted on to the original, necrotic scions. In the former, in other words, transmission to the new, *low jat* scions had been effected via an intermediate component of *high jat* appearance which had remained symptomless. Many of the new scions were strongly necrotic by the end of the year and showed all the typical symptoms of the disease, so that there can be no doubt as to the validity of the transmission, which was effected in a much shorter time than was previously thought possible. The virus nature of the disease, and the susceptibility of the *low jat* material employed, is thus demonstrated by these grafts as well as by the root grafts. The ability of the *high jat* material to transmit the virus without itself becoming visibly affected — technically speaking, to behave as a “carrier” of the virus — is also effectively established. Such “carrying” capacity may easily provide an explanation of the many negative results obtained in the earlier grafting experiments with *high jat* material. If at all widespread in commercial planting material, it will have to be reckoned with in estimating the future spread of the disease in the field. In any case, a great deal of further work will be needed to confirm and extend this observation for different *jats*.

Confirmation of the above experiment was attempted with a number of grafts made to the old inarched plants during June, using the same scion material. As before, grafts were made to both the original stock and scion components. However, much slower progress has been made by these grafts and it has not yet been possible to record them for *Phloem necrosis*.

A third lot of “couple grafts,” more than two hundred in all, was made to bushes in the field during October, but owing to the partial failure of the N. E. monsoon a very large number of deaths occurred, only about 7 per cent surviving by the end of the year. A comparison between these grafts and the ones made in April illustrate the effect of weather conditions rather well. In both cases, the monsoon arrived later than usual and the result, which was very unfavourable in the N. E. season with about a month of hot, sunny weather when rain was expected, was extremely favourable in the S.W., when the heavy rains were preceded by warm, showery conditions under which the grafts united rapidly and very few deaths occurred. April is probably the best grafting month for “couple grafts” in the field and future work will be arranged so that as many grafts as possible can be made then.

For future “couple-grafting” experiments, several new beds have been planted up with necrotic and healthy cuttings of various *jats*. Shade is being provided so that optimum conditions for grafting will be obtained. The plants are making good progress.

"Jat" Differences.—So far, transmission of *Phloem necrosis* has been effected with certainty to material of nine clones belonging to seven *jats*, two Formosan, two from Java, and three of Ceylon origin. These were all selected from the Tea Research Institute's variety trial, laid down several years ago. A clone represents the progeny of a single bush propagated vegetatively, usually by cuttings, and can be presumed to be uniform in genetic constitution. *Jat*, on the other hand, as is well known, is a term used merely to describe the origin of a given supply of seed and within a *jat* a considerable degree of diversity is to be expected. The mother bushes of the clones to which *Phloem necrosis* has now been experimentally transmitted, were all selected for their *low jat* appearance, a character which was believed, on the basis of field observations, to indicate the likelihood of susceptibility to the disease. However, the fact that this surmise has proved to be correct applies only to these particular bushes: *there can be no guarantee that all "low jat" material is susceptible, or that "high jats" are necessarily resistant.* Reaction to *Phloem necrosis* may be expected to exist in three different degrees, namely, susceptibility with more or less recognisable symptoms, "carrying" without symptoms, and complete immunity or inability to become infected at all. In the long run, the reaction of planting material of different *jats* would need to be determined for each bush individually, whereas for vegetatively propagated clones a test of two or three bushes would suffice. While considerable further experience may be needed before the transmission experiments will be capable of easy repetition at will as a routine test, a start is being made by including some of the Institute's selected clones in all future grafting projects.

"False Necrosis."—This term is applied to various kinds of necrosis which have appeared from time to time in different ungrafted plants and control seedlings and have led to difficulties in interpreting the results of transmission experiments. The necrosis has been most prevalent in young seedlings raised in peat, although it has also been found in supplies and mature bushes in the field, and early experience suggested that it might be aggravated by injuries to the root or by abnormal water relationships. These hypotheses have been put to the test this year by the recording of several experiments.

Briefly, it appears that the necrotic condition once recorded in a plant tends to persist in that plant under various treatments: in a given batch of plants there is no suggestion of the necrosis spreading from plant to plant, or affecting different plants at random at successive records. Also, there is no correlation between "false necrosis" and the occurrence of any external symptom or individual characteristics such as size and colour of leaf. The incidence of necrosis was not affected by slicing the roots or by cutting them short on transplanting, although in one batch of seedlings the condition was strongly associated with an abnormal failure of elongation in the taproot. The most encouraging feature of the observations has been the marked diminution in necrosis after planting out into soil. Thus, in one bed of thirty-five plants of which fourteen were necrotic on planting out in October, 1941, eight only were necrotic by May, 1942, and all were normal by the end of the year. Other plantings have tended in the same direction.

"False necrosis" looked like becoming a major difficulty a year ago, when the transmission of *Phloem necrosis* had not yet been satisfactorily achieved. Now that this has been done, however, and the typical external

symptoms of the disease have been reproduced, it can be viewed with greater equanimity as causing at most a slight delay in interpreting the experiments. This is also minimised by the increasing use of "couple grafting" which is suited to plants growing in the field and in beds outside, rather than in pots.

Field Observations.—The recording of the St. Coombs observation plots was postponed on account of the divided pruning of No. 3 field carried out in conjunction with the interplanting of food crops. The full record will be taken again next year.

Rogueing Experiments.—The two field experiments in the Kandapola district were recorded twice during the year, in March and September. A full description of the purpose and method of treatment of these experiments was given in last year's Annual Report (Tea Research Institute Bulletin No. 23, pp. 35-7) and need not be repeated here. The results obtained so far from both experiments are given in Table I:—

TABLE I.

Effect of "Rogueing" Methods of Spread on *Phloem Necrosis*.

Treatment	Original number of healthy bushes	No. of healthy bushes, Sept. 1942.	Decrease representing increase in disease	%
(First Experiment)				
A	212	90	122	57.5
B	200	112	88	44.0
C	210	144	66	31.4
(Second Experiment)				
A	101	61	40	39.6
B	89	61	28	31.5
C	125	91	34	29.6

The treatments — (A), control from which no bushes are removed; (B), removal of non-productive bushes only; (C), removal of all bushes marked by the Tea Research Institute as "necrotic" or "suspected" — are carried out every six months, the first experiment having been started in August 1940, and the second in March, 1941. "Rogueing" means literally the removal of "rogues" or off-type individuals from a population which it is desired to keep pure. The word is used particularly by seedsmen and growers of, *e.g.* potato varieties, and is also frequently applied, as in the present case, to the removal of diseased plants as a measure of control for virus or other diseases.

In both experiments, the "A" plots show the largest, and the "C" plots the smallest percentage increase of diseased bushes as represented by the equivalent decrease in the number of healthy bushes since the start of the experiment, so that it appears that the "rogueing" of diseased bushes has been effective in checking the spread of the disease. In the first experiment, the results attain a high level of statistical significance, but in the second experiment, the degree of significance is lower, the differences between the treatments being less marked owing probably to the initially higher incidence of necrosis (shown by the much smaller

numbers of healthy bushes present originally). The value of the conclusions which can be drawn from these experiments (*loc. cit.* p. 37) will increase at each subsequent occasion on which confirmatory results are obtained. After the next two or three records, there should be sufficient data to warrant an attempt at mathematical analysis.

Grateful thanks are due to the Superintendents of Goatfell and Concordia Estates for their continued co-operation in these experiments.

Entomological Work.—Of the large number of sucking insects recorded from tea and listed in the report of the Entomologist for 1940 (Tea Research Institute Bulletin 22, p. 43), the Brown Scale, (*Saissetia coffeae*) is regarded as the most likely vector of *phloem necrosis*, on the grounds of its prevalence in the badly affected areas and of its localised distribution and limited powers of dispersal, both of which characters find a parallel in the known behaviour of the disease in the field. The entomological work is at present being confined to this insect in order that this hypothesis may be put thoroughly to the test: a concentrated attack of this sort will, it is believed, prove more fruitful of results than experiments carried out at random on a succession of insects of more or less unknown habits.

Work with *Saissetia coffeae* during the year has again been carried out in conjunction with the Entomology division. It has fallen roughly into a fourfold programme, viz:—

(1). Measurements and observations on insects occurring naturally on necrotic shoots brought in from the field.

(2). An experiment involving the inoculation of a number of selected *low jat* cuttings, each with a single insect known to have fed previously on a necrotic shoot. This was carried out as a transmission experiment, with the additional aim of following the life-history of the insect.

(3). Further life-history data were obtained from the progeny hatched out in the laboratory from some of the insects used for the experiment above and left on the original cuttings, as well as from others transferred on the day of hatching to cut shoots for individual observation.

(4). A "mass-inoculation" experiment, transferring thirty or forty insects at a time from necrotic shoots to healthy *low jat* cuttings of a type believed to be susceptible to the disease, *i.e.*, giving the maximum opportunity of effecting a possible transmission.

None of the inoculation experiments so far has given any transmission results and it is still too soon to consider the 1942 inoculations from this point of view. Meanwhile, the life-history data at present available can be summarised under the topics of the number and duration of the instars, hatching rate and survival, motility, and the percentage of successful transfers.

Size measurements of a natural population of insects of different ages gave a three-peaked distribution curve suggesting the occurrence of at least three instars. However, later observations in the laboratory showed the number of instars in the complete life cycle to be four, all three moults being distinguishable. The last instar, representing the adult stage, is terminated at maturity by egg-laying, a process which is accompanied by a hardening and raising up of the scale. This condition, which

is usually fairly easy to recognise, is followed later by the emergence of the young offspring. The following Table gives some typical figures showing the duration of the different stages:—

TABLE 2.
Duration in days of stages in life-cycle of *Saissetia coffeae*.

Stage:—	1st instar	2nd instar	3rd instar	4th instar (to maturity)	Maturity to emergence of offspring	Total for complete life-cycle
(average)	28	21½	25½	38½	18½	130
(limits)	(20-41)	(12-41)	(18-51)	(19-59)	(15-22)	(102-146)

Other insects, which failed to complete their life cycle in the period of observation, were still apparently alive and feeding, up to 200 days after hatching.

The offspring in *S. coffeae* are hatched *in situ* and emerge gradually from beneath the parent scale over a period of a fortnight or more. Consequently, their numbers are difficult to determine with certainty. The maximum number observed at one time was seventy, the average for all the insects in which counts could be made being between forty and forty-five. According to some authorities the total number of offspring may reach several hundred. The numbers surviving after hatching declined rapidly during the first few weeks, the rate of decline afterwards gradually decreasing until, in some plants, an ultimate survival of about 10 per cent only was reached. Where the offspring were transferred and kept under individual observation the survival was rather higher, about 25 per cent of the insects reaching maturity.

After hatching, there is a general tendency for the youngest, first instar nymphs to move towards the apex of the shoot. Later, the more mature scales tend to be found at the base of the shoot and on the older, banji leaves, where they occur chiefly on the lower surface. Of the insects which were reared through their complete life-cycle in the laboratory, about 25 per cent made no further movement after transfer (*i.e.*, after the initial period of more or less active crawling about). In the remainder, however, the degree of motility was surprisingly high, up to eight separate 'movements' being recorded. Since the position of the insect could only be noted at definite, usually two-day, intervals, each of these recorded 'movements' may include more than one change of position. Motility occurred in each instar and in some cases continued until immediately before egg-laying. The usual tendency was to move at least to an adjacent internode of the stem, or from a leaf to the adjacent internode, or *vice versa*, rather than to move a shorter distance within a given leaf or internode. The maximum observed distance of movement was about 10 cm. at a time. Previous investigations showed that the adult insect was a phloem feeder, and observations which are still in progress (by J. Bond) show that the phloem is also reached by the stylets of the young nymphs in their first instar within a few days of emergence. This fact, coupled with the continued motility of the insect, is of obvious significance relative to its possible role as a vector of the *Phloem necrosis virus*.

Valuable experience in handling the insects has been gained during the year, and the percentage of successful transfers, as judged by the numbers of insects which have settled down and survived for at least a week while apparently feeding, is about seventy per cent; 25-30 per cent have survived to maturity and the subsequent emergence of offspring. It has been shown that the insects can be moved while stationary, the stylets being withdrawn after slight stimulation.

Anatomical Work, Etc.—The anatomy of healthy tea continues to be studied in order to provide a background for the work which will eventually have to be carried out on the precise characterisation of *Phloem necrosis* in its anatomical aspects. The use of the foliage leaf as the readiest means of diagnosis of the disease indicated the flush shoot as the first object of anatomical study and this in turn led to a consideration of the periodic development of the apical bud which forms the basis of the regular flushing habit in tea. The first instalment of this work was completed early in the year when a manuscript entitled: "Studies in the vegetative growth and anatomy of the tea plant (*Camellia thea* Link.) with special reference to the phloem. I — The flush shoot" — was submitted for publication in a botanical journal in England. Subsequently, further data have been collected on both the anatomical and developmental aspects — the latter largely for its great intrinsic scientific interest, the former towards a continuation of the study of the structure and development of the phloem tissue in the older parts of the stem and in the root.

C. H. GADD,
Mycologist

REPORT

OF

THE ENTOMOLOGIST

FOR 1942

Staff.—The Entomologist remained on active service with the military forces during the whole year and the Mycologist continued in charge of the Division.

Advisory.—406 letters were received and 492 despatched. 63 consignments of insects were examined, of which 13 related to mites and 6 to nettle grubs. No insect pest was unduly prominent during the year.

Tortrix Parasite.—Two collections of tea tortrix larvae were received for examination from the Uda-Pussellawa and Hewaheta districts. The caterpillars in both instances were found to be already parasitised by *Macrocentrus*.

Brown Scale.—In view of the possibility that the virus of the *Phloem necrosis* disease of tea may be transmitted by Brown Scale (*Saissetia coffeae*), investigations were started, in co-operation with the Assistant Mycologist, to ascertain particulars regarding its life history and habits. A summary of the work will be found in Dr. Bond's report on *Phloem necrosis* investigations.

Shot-hole Borer of Gliricidia.—Living gliricidia branches sent from the Hatton district were found to be invaded by *Xyleborus semigranosus* Blandford. As the galleries are mainly confined to the pith the beetle's presence is unlikely to be noticed till the tree is lopped.

Tea Chest Borers.—Two consignments of plywood for tea chests invaded by borer beetles were received during the year. One plywood was of Japanese origin and was invaded by *Lyctus brunneus* Stephens, the other was of local manufacture and was invaded by *Heterobostrychus aequalis* Waterhouse. Both beetles confine their attention to wood containing starch which is an essential constituent of their food. This fact is of considerable economic importance as it indicates that the use of starch-free timber would eliminate the risk of damage by these borer beetles.

White Grub.—Numerous vegetatively propagated plants have been killed in the clonal plots of the Physiological Division this year, and the symptoms suggest injury as a result of insect attack. Each cutting consists of a short length of stem with a leaf and its bud at the upper end. Roots arise from the base of the stem, and the bud

develops to form the above ground parts. The injured plants had the bark removed from the stem of the cutting as though it had been gnawed by an insect. White grubs, the larvae of chafer beetles, were found around the plants and consequently came under suspicion. Somewhat similar injuries have been observed on tea seedlings, young gum plants and well grown Hibiscus cuttings, the bark being completely removed from a length of stem just below ground level. Tea seedlings, half inch in diameter, have been seen to be girdled in this way, the bark being completely removed over a length of $2\frac{1}{2}$ inches. Such injuries always result in the death of the plants.

The damage to plants by chafer larvae is usually restricted to roots. It is not unusual to find wilted seedlings in a garden which have only a short stem embedded in the soil, are entirely lacking in roots, and near which one or more white grubs may be discovered in the soil. White grubs certainly destroy tea roots and in some instances are known to bite through the tap root just below ground level. That type of injury has been fairly common in some tea clearings on patna soils. Ringing of tea plants has not previously been attributed to white grubs. Concerning chafer larvae in the British Isles, Fidler reports that two species *Amphimallus* and *Serica* have the habit of girdling stems and roots, especially of young trees, whereas another white grub, *Melontha*, generally bites through the plant.

In order to ascertain whether chafer larvae were responsible for the girdling of tea plants 24 rooted cuttings were planted singly in 6-inch pots and one white grub was added to the soil of each of 12 pots. The remaining 12 pots were kept as controls. Two months later, in November, the plants were knocked out of the pots for examination. No injury was found on any of the control plants. White grubs were not found in 5 of the 12 pots in which they had been placed. Of the 5 plants growing in these pots, 3 showed slight injury, the bark having been gnawed from small areas, and two were not injured. Of the plants growing in the 7 pots from which white grubs were recovered, 3 were severely damaged, the stems being completely girdled as observed in the field; 2 showed slight injury and 2 were unharmed. There appears fair reason for concluding that white grub, on occasions, may cause the death of young tea plants by gnawing the bark and thereby ringing them.

SHOT-HOLE BORER.

Hard and Light Plucking Experiment.—Data collected during the course of this experiment which terminated in December, 1941, have been studied and published in *The Tea Quarterly*, Vol. XV, pp. 31-40. The hard plucked bushes were less severely attacked than the more lightly plucked bushes and the attack in all plots was most severe during the second year from pruning.

Manuring and Branch Breakage.—It has long been recognised that the only satisfactory treatment of shot-hole borer attack is by manuring liberally to counteract the effect of the beetles. Investigations by Jepson and Gadd published in 1926 indicated that manuring had no direct effect on the beetles and that the main benefit to be derived from manuring is to be found in the accelerated healing of the galleries. The galleries made by the beetles so weaken the stems that they become very liable to break. If, by manuring, the rate of growth is speeded up and the

damaged branches are thereby strengthened, it might be expected that the number of broken branches in manured plots would be smaller than in plots receiving no manure.

This hypothesis has been tested during the year by making counts of broken branches after every plucking in each plot of a manuring experiment laid down by the Agricultural Chemist at Passara. The plots had been pruned in September 1940 and the first count of broken branches was made on January 31st, 1942, when the plots were 16 months from pruning. The branches then collected, numbering 2,689 in all, probably consisted of all the breakages which had occurred in the whole experimental area, 3.2 acres in extent, since the bushes were pruned. After the next 3 plucks, 1,183, 1,364 and 1,271 broken branches were collected respectively. At successive pluckings the numbers steadily increased to 2,709, on May 29th, 1942, and remained about that level till July 10th. After that date the numbers decreased, till in December less than 600 were collected after each plucking. In December therefore the breakages were less than half of what occurred in the previous February.

These figures tend to confirm a statement made in the last annual report, namely that bushes in plucking are attacked by shot-hole borer mainly during the second year from pruning. Observations will be continued through the third year to ascertain whether an increase in the number of broken branches will recur in the period May to July 1943.

A preliminary examination of the data collected from individual plots gives no indication that broken branches have been less numerous in the manured plots than in the unmanured plots. By October 2nd, 1942, at the beginning of the third year from pruning, 6,093 broken branches, exclusive of those removed at the first examination, were collected from the plots receiving no manure and 8,243 from the plots receiving potash only. Other treatments gave numbers ranging between these extremes. These results and their significance will be discussed later when the full data have been more closely studied.

Wood Rot and Shot-Hole Borer.—Experiments were carried out to ascertain to what extent attack by shot-hole borer influenced the development of wood rot in pruned branches. An account of the experiments was prepared for *The Tea Quarterly*, Vol. XV. No. 3, and need not be repeated here. It will be sufficient to state that both dieback and wood-rot were more extensive in shot-hole infested than in non-infested branches.

NETTLE GRUB.

Occurrence.—Nettle grub was reported this year from 8 estates in Uva as compared with 11 estates in 1941, distributed as follows: Badulla district 3, Passara district 3 and Madulsima 2. The chief species concerned was the Fringed Nettle Grub (*Natada nararia*).

Ecology.—Nettle grubs, like many other pests, occasionally occur in tea fields in rather large numbers and then disappear as suddenly as they appear. Nothing is known concerning the conditions which favour these sudden appearances, nor of the factors which lead to their disappearance. If such were known the forecasting of epidemics might be possible and measures taken to deal with them before, and not after, severe damage is caused.

As a beginning, field observations were made to determine the number of nettle grubs occurring in tea throughout the year. An area of about one acre in a field 3 or 4 months from pruning was selected on Gonakelle Estate, Passara, for the purpose. Each week beginning on March 31st, 1942, 40 bushes were selected at random and each was searched for nettle grubs, their number and other observations being recorded. The nettle grub **most** in evidence throughout the year was the Fringed Nettle Grub, *Natada nararia*, and the following observation refer to that species. The numbers given refer to entire collections from 40 bushes.

At the first examination, at the end of March, 869 living grubs were found and by April 14th the number had reached 1,802. On no occasion during the remainder of the year were so many larvae found again. Moths and newly laid eggs were observed on May 12th and newly hatched larvae on May 17th. The maximum number of larvae found of this, the second generation was 192, on June 16th. No living larvae were found from July 28th till August 11th when newly hatched larvae of the third generation were found. This generation was even smaller than the second as the largest number collected on any occasion was 28, on September 1st. The fourth generation was yet smaller. The young larvae were first seen on October 27th and the maximum, 19, was reached on November 17th.

On no occasion were old larvae of one generation found at the same time as newly hatched larvae of the next generation. Consequently a fair estimate of the length of the life cycle of the insect can be obtained from the intervals between the first appearance of newly hatched larvae of succeeding generations. The interval between the emergence of larvae of the second and third generations was 12 weeks as compared with 11 weeks between the third and fourth generations. These estimates are somewhat larger than what was expected from laboratory data given by Austin in *The Tea Quarterly*, V, pp. 6-7. The average times of incubation, larval and pupal stages given there are 6, 36 and 21 days respectively totalling only 63 days or 9 weeks.

It was also noted that nettle grubs in other fields were in approximately the same stage of development as in the observation plot. In one field (No. 10) on October 14th only one living full grown *Natada* was found on 20 bushes examined. A fortnight later (October 28th) 15 newly hatched larvae were collected from 20 bushes. In the experimental plots newly hatched larvae were found on October 27th. In another field (No. 3) no living larvae were found on October 7th but on November 4th when another examination was made newly hatched larvae numbered 56 from 20 bushes. It is evident therefore that eggs hatched in all three fields about the same time.

Parasites.—Hitherto, 'wilt' disease and the hymenopterous parasites *Fornicia ceylonica*, *Rhogas* sp. and *Apanteles* sp. were considered to be the main factors controlling nettle grubs. These parasites become evident after the grubs are half grown and a certain amount of damage has been done. Observations in the field this year indicate that smaller parasites, belonging to the tribe *Euplectrini*, cause considerable mortality amongst young larvae when about quarter grown and before much damage has been effected.

Predator.—The predacious bug *Cantheconidea robusta* Dist. was first observed to prey on the Fringed Nettle Grub in Ceylon by Light in 1928 (T. R. I. Bull. No. 3, p. 38). Since then it has been frequently noticed

and a few notes on its life history were published in the Annual Report for 1931. During the year further observations have been made by Messrs. Austin and Fonseka at the Passara laboratory.

The adult bugs are dark brown and $\frac{1}{2}$ to $\frac{3}{4}$ inch in length, the male being somewhat smaller than the female. Their longevity has not been determined as the experiments had to be terminated prematurely for lack of nettle grubs as food. Twelve adults had then lived for 51 days. A somewhat similar species in the Dutch East Indies, *C. furcellata*, is reputed to live at least 3 months.

Egg laying begins 9-17 days after the last ecdysis. The eggs are bronze in colour and are deposited in groups on the tea leaves. The number of eggs in each mass varies considerably, the largest observed being 137. The greatest number of egg masses laid by one female was 16, and the largest number of eggs 929.

Egg laying begins 9—17 days after the last ecdysis. The eggs are bright red and are gregarious in habit. They are always to be found bunched together quite close to the egg mass from which they emerged. They do not feed during the first four days and the gregarious habit continues till the 3rd or 4th moult. In all 5 moults occur during the nymphal period of 23 to 28 days.

Both adults and nymphs feed readily on all the commoner species of Nettle Grubs, *Natada nararia*, *Thosca cervina*, *T. recta* and *Parasa lepida*. They approach their victim stealthily, drive their stiletto-like mouth parts into the side of its body and suck out the body juices. Owing to the gregarious habit a young nymph rarely succeeds in keeping its prey for itself as others assist at the kill and the meal. It is not unusual to find a nettle grub completely surrounded by *Cantheconidea* nymphs. Adults hunt alone. Observations on 20 nymphs and 20 adults fed in captivity showed that one of these predacious bugs consumed 28 *Natada* larvae during the nymphal period and 101 larvae during 6 weeks of adult life.

These figures suggest that *C. robusta* may play a more important part in the natural control of nettle grubs than is generally recognised.

C. H. GADD,
Acting Entomologist.

REPORT

OF

THE AGRICULTURAL CHEMIST

FOR 1942

Staff.—There have been no changes in staff during the year.

Advisory.—Letters received numbered 392 and those despatched 273. As regards the normal work of the division, the correspondence has chiefly concerned manuring. As was reported previously, war conditions have made the strict adherence to manurial programmes impossible. In these circumstances the Agricultural Chemist has been called upon to advise on new programmes, especially on the best way to overcome the difficulties of irregular manurial intervals. There has also been considerable correspondence on the subject of food production.

Food Production.—In consequence of the liaison that has been arranged through the Co-ordinating Advisory Committee on Food Production on estates, between the Research Stations and the Department of Agriculture, this division has taken over the three Planters' Association districts of Dimbula, Dickoya and Dolosbage-Kotmale for advisory supervision. In addition, the department has co-operated in the production of the special food production leaflets dealing with soil management and manuring, and the senior officer has edited for the Department of Agriculture the occasional Food Production News-Sheets.

The areas chiefly used for food production were those outside the actual tea acreages. Apart from the fact that, in general, at these elevations compliance with the Food Production (Estates) Order by means of interplanting would need in any one year the whole of the pruned tea (which was naturally not planned to be pruned in the exact season suitable for food crop planting), there was a marked reluctance to use tea land owing to fears of competition and falling-off in yield of the permanent crop. Observation showed that these fears were altogether groundless if food crops were sown as soon as possible after planting. Such competition as occurs seems to be entirely in favour of the tea, which, since it is an already firmly established crop, should not occasion any surprise. Those areas specially planted on newly opened ground that were visited in the course of advisory work were almost entirely failures. Late seed delivery, hurried preparation leading to inadequate cultivation, and markedly unsuitable weather conditions, all played their part in ruining attempts to raise crops; but when due allowance has been made for all these, it seems certain that the administrative authorities responsible for the scheme, without sufficient consideration of the technical questions involved, committed estates to a hopeless task. The fact that in England, the ploughing up of grassland has enabled grain and root production to be enormously increased within one farming year is no argument for a similar project in Ceylon

It has been one of the aims of this department to make it much more generally known than is at present the case that, wherever crop production is carried out in an intensive manner, the fertility which makes this possible is largely man-made and is the result of generations of judicious cropping, rotation and stocking.

Cost of Living Index.—During the course of the year the Government imposed a uniform 'dearness allowance' to be paid on the daily wage of all Indian immigrant labour employed on estates. Month by month the amount of this allowance was varied in accordance with a Cost of Living Index computed by the Department of Labour. This Index was not calculated by a trained statistical officer, and, in order to assure itself that the Labour Department's computations were valid, the Planters' Association sought the help of the Agricultural Chemist in view of his previous association with Professor R. A. Fisher, Sc.D, F.R.S., Galton Professor of Eugenics in the University of London and formerly Chief Statistician to the Rothamsted Experimental Station. Accordingly advice has been given on this subject by the Agricultural Chemist acting as an independent technical adviser. In the course of the year, several visits have been paid to the Department of Labour for informal discussion and on one occasion for a formal deputation to the Minister of Labour, Industry and Commerce.

A number of technical defects were found in the computation of the Index and in its application to the dearness allowance. Chief amongst these were the following:—

- (1) Error in weightage for rice.
- (2) Error in weightage for men, women and children in terms of equivalent adult units. The dearness allowance is based on proportions of 5:5:3 respectively whilst the budget from which the Index is calculated adopts the scale 5:5:4 recommended by the League of Nations Health Organisation.
- (3) Non-correspondence between dearness allowance and Index for Mid and Low country areas.
- (4) Deviations from the statistical conventions applicable to approximations in calculations.
- (5) The use of too few price quotations for the calculation of average prices.

A report on these defects has been made and transmitted to the Government, but at the time of writing no action has been taken in the matter.

Publications.—A New Method for the Determination of Total Phosphoric Acid in Soils. J. G. Shrikhande. Journal of Agricultural Science, 1942, Vol. 32, pp. 406-412.

FIELD EXPERIMENTS.

Manurial Response.

(a) **Within the Cycle.**—The question of manurial response continues to occupy a prominent position in the design and interpretation of field experiments. So far two important points have emerged (1) the directly proportional response to increasing nitrogen applications even up to 80 lb. of

nitrogen per acre and (2) the relatively less efficient response to manurial doses at the time of pruning than at a later date if the bush is largely or entirely depleted of leaves. Recently efforts have been directed towards determining variation in response throughout the pruning cycle, and from season to season.

For the former purpose an experiment was laid down whose design was reported in the Annual Report for 1940. The first cycle of this experiment has just been concluded. For purposes of experiment manuring was done at 6, 16 and 26 months in a 36 months cycle. The first application was made at a uniform rate of 30 lb. per acre of nitrogen. For the second application three levels, viz. 30, 45 and 60 lb. of nitrogen were chosen and nine plots were assigned to each of these treatments. For the last application the same three levels were maintained, but not on the same plots. For three treatments carried out on each of two occasions there are 3×3 possible combinations and all nine are represented in the experiment.

The results from the first cycle are given in Table I.

TABLE I.
Manurial Cycle Experiment.

Yields per acre in lb. dry matter (last period).
Figures in *italics* are deviations from general mean.

		Nitrogen treatment in 2nd period		
		30	45	60 lb.
Nitrogen treatment in 3rd period. lb.	30	1005 (-24)	899 (-30)	1019 (-10)
	45	1071 (+42)	993 (+36)	1103 (+74)
	60	1056 (+27)	1026 (-3)	1087 (+58)

The table is set out so as to show how the various combinations of second and third doses affect yield during the last period. The maximum difference between any two combinations is just less than twenty per cent, and the accuracy of the experiment is not such that even this difference can be relied on. There is no general trend, statistical consideration of which might enhance the accuracy of the data and thus reveal significant response. All the plots which received 45 lb. of nitrogen at the second application are subnormal in yield and similarly all those which received 30 lb. of nitrogen at the third application. The latter observation is according to expectation, but there is as yet nothing to indicate that a high dose, given previously, compensates, in any way for subsequent parsimony, at any rate on a short view. Taken altogether these results indicate that this young tea (planted in 1931) has not benefited by the higher doses. There is a good regular stand of grevilleas on the experimental area, and one of the aspects of this trial to be watched is whether any evidence can be gained on the response to manuring in the presence of permanent shade.

The same experiment is designed to supply information about soil and crop changes when using physiologically acid and alkaline manures respectively, in this case, sulphate of ammonia, nitrate of soda and a mixture of the two. Soil samples were taken before the trial began, and at the start of the new cycle, and on these, changes in reaction value will be followed. Table II gives the yields per acre for equivalent doses of nitrogen as nitrate of soda, sulphate of ammonia and the mixture, in their respective increments, for the last manurial period of the cycle by which time the effect of two applications should be visible.

TABLE II.
Effect of Different Forms of Nitrogen
Yields per acre in lb. Dry Matter
(26-36th month)

Figures in italics are deviations from general mean.

lb. Nitrogen applied	Ammonium sulphate	Mixture	Nitrate of soda
30	938 (<i>—91</i>)	1007 (<i>—22</i>)	978 (<i>—51</i>)
45	1134 (<i>+105</i>)	1015 (<i>—14</i>)	1018 (<i>—11</i>)
60	1082 (<i>+53</i>)	1078 (<i>+49</i>)	1009 (<i>—20</i>)
Mean	1051 (<i>+22</i>)	1033 (<i>+4</i>)	1002 (<i>—27</i>)

There is again no difference which can be confidently relied upon, but the general pattern of the yields is of interest as showing what to watch in further developments. All the 30 lb. nitrogen yields are below the average which is to be expected. The behaviour of the 45 lb. N dose shows a gain for sulphate but a deficit for both the mixture and the nitrate, whilst at the highest level of nitrogen viz. 60 lb., both the sulphate and mixture exceed the average, the nitrate remaining consistently below par all through. These variations can be accounted for purely by chance, but they are nevertheless not inconsistent with the view that there is an adverse factor at work in the case of nitrate of soda which higher dosage or mixture with sulphate of ammonia to some extent decreases. Further work will resolve the problem more completely.

(b) **Within the Season.**—The experiments which have been carried on at Passara for some years have figured little in these reports. The reason for this is that the results were much less positive than at St. Coombs and it has taken longer for their trend to make itself plain. The vagaries of the weather make the interpretation of experimental results in Uva much more difficult. But it is becoming clear that the prolonged dry season affects manurial response in two ways. As far as gross increases are concerned these are naturally curtailed, which is the main reason why significant results have been slow to appear. But in general the response to manure on a percentage scale is not adversely affected to any large extent.

Table III gives a summary of results on seasonal response for two experiments at Passara and one at St Coombs. The year is divided into three periods of four months each. February-May; June-September; and October-January. The weather throughout these periods is fairly well defined though different on the two sides of the mountain divide. In all

cases the figures refer to the last year in the cycle, so that results are affected as little as possible by changes in the size of plucking table. The figures for Passara show that in the critical dry period, June to September, response is increased in comparison with the previous one, and, in the one case for which there are data, comes not far short of the North-East monsoon response that follows. The corresponding figure for St. Coombs during wet weather is very striking, being the largest response of any. Taken all together these data show that under adverse weather influences, manures are at least proportionately as effective as at other times, and that they are to some extent an insurance against loss of crop in bad seasons.

TABLE III.

Mean Per cent Response to Manuring in Various Seasons.

Place and Experiment	Feb.-May	June-Sept.	Oct.-Jan.
Passara I (2 cycles)	17	30	37
Passara II (2 cycles)	12	17	—
St. Coombs N. P. K. (3-cycles)	19	57	30

The factorial manurial experiment is just about to complete its fourth pruning cycle. Consideration of the results is accordingly deferred till the whole cycle data can be considered. The same applies to the cultivation, weeding and manurial dosage experiment.

Hard Plucking.—The experiment on hard, *i.e.* fish leaf plucking versus normal plucking has completed its second year. The appearance of the plots has shown striking differences and these have been reflected in yield. The plots plucked consistently to the fish leaf since the start of the experiment have developed a very jaded looking appearance but they have yielded very much higher yields though the size of flush has diminished rapidly. Flush counts were made over five consecutive pluckings on the dry weight samples. From these figures an average weight of flush was derived. When combined with the yields during the same period they show that eighteen months after plucking started, the number of flush shoots plucked from the fish leaf type of plucking-table was nearly twice that from a plucking table where the normal foliage leaf was left above the fish leaf. The actual figures per plucking are, Normal 22 shoots, Fish leaf 40 shoots. The weight of the normal shoots was 42 per cent greater than that plucked to the fish leaf.

TABLE IV.

Effect of Normal and Fish Leaf Plucking on Yield of Flush.

	Normal plucking	Fish leaf plucking
Yield in lb. (5 rounds 1,600 bushes)	44	55
Average weight of individual flush, gms. dry weight	0.112	0.078
Average number of flush shoots per bush	22	40

T. EDEN.

Agricultural Chemist.

REPORT

OF THE

THE PLANT PHYSIOLOGIST

FOR 1942

Staff.—The Mycologist remained in charge of the work of the Plant Physiology Division during the year. The work in connection with weeds, green manures and cover crops was carried out by Dr. Bond who has contributed the section of this report under that heading.

It is a pleasure again to record our appreciation of the assistance given voluntarily by Mrs. T. E. T. Bond.

Advisory.—80 letters were received and 85 despatched.

Clone Tests.—The propagation of selected bushes for preliminary trials was continued. During the year 26 clones were put into the field and one of the previously planted clones was discarded, making a total of 74 now under observation. Light plucking of 4 to 5 year old bushes of 14 clones has been started and 15 rounds at 9-day intervals were completed by the end of the year.

Transfer to Baskets.—In many previous experiments tea cuttings were first planted in a propagation bed and as roots developed the plants were removed to soil in baskets. One object of that procedure was economy in baskets: cuttings which failed to root were not basketed. It was also a convenient method for determining the percentage of cuttings which had rooted in a given time. Such experiments afford no evidence that the best time to move the cuttings is after roots have appeared: it may be better to move them earlier, say when a callus has formed. An experiment was therefore designed to obtain information on this point and also to apply a further test concerning the relative merits of soil and a mixture of soil and peat as rooting media.

600 cuttings were used, 150 from each of 4 selected mother bushes (clones 1, 2, 3 and 4). Each treatment was applied to 100 cuttings, 25 from each mother bush. 100 cuttings were planted directly into a mixture of one part peat and three parts soil (Treatment A) and another 100 into baskets of soil (Treatment B.) All baskets were placed in the open and shaded with fern. The remaining cuttings were planted in a mixture of peat and sand which is known to encourage callusing (T. R. I. Bulletin No. 22, p. 70). Two months later, in July 1941, when 50 of each clone had formed a callus they were removed to baskets of peat and soil (Treatment C) and of soil (Treatment D). The non-callused plants were similarly basketed (Treatments E and F). Callusing was carried out in a propagation shed covered with mana grass.

In March, 1942, ten months after the cuttings were made, the surviving, growing cuttings were counted. The results are shown in Table 1 from which it will be evident that clones 1 and 4 are better rooters than clones 2 and 3. Differences between the rooting capacity of cuttings taken from different mother bushes have frequently been noted previously.

TABLE 1.

Number of plants surviving after 10 months when cuttings are removed to baskets at different stages of growth.

Treatment	Clones				Total
	1	2	3	4	
A. To peat and soil, direct	23	22	18	25	88
B. To soil, direct	23	20	19	24	86
C. To peat and soil, callused	22	16	13	23	74
D. To soil, callused	22	16	17	22	77
E. To peat and soil, not callused	22	15	15	22	74
F. To soil, not callused	22	9	13	20	64
Totals	134	98	95	136	463
Percentage	89	65	63	91	

For treatments A, C and E a mixture of peat and soil was used whereas soil alone was the planting medium for treatments B, D and F. By adding the totals given in the last column for these two groups it will be seen that when a mixture of peat and soil was used 236 or 79 per cent of the cuttings survived as compared with 327 or 76 per cent. for soil alone. The difference between the observed results is of no real importance.

Similarly a comparison can be made between the results obtained when the cuttings are planted directly into baskets and when a pre-treatment to encourage callusing is given. Of the 200 cuttings planted directly into baskets 174 or 87 per cent. survived as compared with 151 or 76 per cent. when the cuttings were transplanted after callusing, and 138 or 69 per cent. when the cuttings had undergone callusing treatment but had failed to callus. These differences are sufficiently large to be of importance. Obviously, the pre-treatment has no positive value and may well be eliminated.

Planting in Nursery Beds.—Other experiments have given rise to considerable doubt that the provision of a thatched shed is essential for the propagation of tea cuttings, so an experiment was designed to compare the behaviour of cuttings planted under cover and in the open. Four beds were prepared in the way suggested in the *Tea Quarterly*, Vol. XIV, p. 103, two in the open and two under a thatched shed. The beds all had 3 inches of cinders below, to ensure good drainage and 8 or 9 inches of soil or a mixture of peat and soil in equal proportions above. In November 1941, 400 cuttings were obtained from one mother bush and were equally distributed amongst the four beds. The cuttings placed in the open beds were shaded with fern immediately. The numbers rooted after 5 months are shown in Table 2.

TABLE II.

The number of cuttings rooted after 5 months when grown in the open and under a thatched roof.

Treatment	No. of rooted plants	
In shed, peat and soil	66	} 127 or 63.5%
In shed, soil	61	
In open, peat and soil	82	} 162 or 81.0%
In open, soil	80	

The cuttings in the open gave markedly better results than those grown in the shed, 81 per cent rooted in the open as compared with 63.5 per cent in the shed. Again no great advantage was derived from the admixture of peat with the soil, 74 per cent rooted in the mixture as compared with 70.5 per cent in soil. The slight advantage derived from the use of peat under these circumstances does not warrant the extra cost involved.

Losses in the Field.—In 1941, 153 three-year old (approximately) plants were centered at 4 inches and 41 or 27 per cent subsequently died. Some of the deaths could not be attributed directly to the centering operation as, for instance, 4 plants had been ringed just below ground level. The roots of 25, or 78 per cent, of 32 dead plants examined, were found to be very deficient of starch. That fact probably accounted for the failure of the majority of the plants to recover from centering. This loss is considered to be unduly heavy at this elevation and to be greater than would be expected from seedlings of the same age, though strictly comparable figures are not available.

In view of the heavy loss following normal centering it was decided to cut back young plants 9 to 12 months old in 1942 so that the prune would not leave them destitute of leaves. The objects were to begin shaping the bushes at an early age and to encourage low branches. Some ciones tend to form low branches very early whereas others tend to run up on single stems. The majority of cuts were made at 8 inches or less. 27 or 3.3 per cent of the plants died after pruning and of these 13 died as a result of injury just below ground level, the bark being removed as a complete girdle. This type of injury of course was not a result of the cut back but was suspected to be the result of insect injury. Loss from pruning at that age was therefore very small, and in general the results are considered to be satisfactory.

Losses amongst the very young plants put into the field this year have been very high. Of 1,469 put out, 740 or 55 per cent, have died; losses in 1941 amounted to 17 per cent. Plants have been put into the field at a very early age, shortly after basketing and heavy losses are to be expected if inclement weather follows planting. This year losses from insect injury have been particularly heavy, as many as 146 of the plants have been found to have the bark completely removed from the original cutting. The insect suspected was white grub, the larva of the cockchafer beetle, as these pests were found in the vicinity of most of the damaged plants. White grubs are known to eat the roots of young plants and it

is probable that many were severely damaged in that way, but the ringing of tea plants by the removal of bark only just below ground level is not an injury usually ascribed to white grub. The Entomological Division has carried out experiments to determine whether white grubs cause that type of injury, and an account of them will be found in the report of that division.

A good deal of damage was also done by thieves. Sweet potatoes were grown between the rows of young tea plants and nightly removals began long before the tubers were mature. Many young tea plants were trampled and broken.

WEEDS, COVER CROPS, GREEN MANURES, ETC.

The following report has been contributed by Dr. T. E. T. Bond.

Advisory Work.—Forty-four enquiries were dealt with from 33 estates. They concerned 9 species of green manure shrubs and shade trees and 30 species of cover crops, weeds, and miscellaneous plants. Four of these are given separate mention below.

(1) *Biophytum proliferum*.—The question was raised whether this well-known ground cover might be harmful in tea owing to excessive root competition. This difficulty has always to be faced in adopting any policy of "selective weeding." On the estate in question, the primary consideration seemed to be the necessity for preventing soil erosion, and, under such conditions, the maintenance of a ground cover is almost essential. The alternatives are the certainty of irrevocable damage from erosion, and a possible and in any case temporary loss of crop due to root competition. In general, a well-chosen cover crop will compete with tea only when the latter has been forced to feed on the surface as a result of past loss of soil through erosion. The function of the cover crop will be not only to arrest, but to reverse the process of denudation; in time, a new surface soil will be accumulated and the danger of the root competition will no longer exist. During this regenerative process, care may be necessary to prevent the ground cover from forming too dense a mat around the bushes, and causing interference with cultivation.

(2) *Callistemon* sp.—This is a tree with thick, spongy bark, two bags of which had been sold locally for five rupees. A specimen twig was identified at Peradeniya as belonging, apparently, to a species of *Callistemon* which is an Australian genus of the same family, *i.e.*, *Myrtaceae*, as the Gums. The closely related species *Melaleuca leucadendron* is a well known Malayan tree of which both the bark and the fruits are valued medicinally and doubtless the bark of the tree in question had been purchased as a substitute for the imported product.

(3) *Ficus hispida*.—A small tree or shrub with opposite, very rough and hispid leaves which are used when dry as a substitute for sandpaper—hence the English name of "Sand-paper tree." The "fruits" *i.e.*, figs), being produced at or below ground level, are easily mistaken for tubers, which was the description given to them when sent in for identification. However, on being cut open they were found to be hollow inside and lined with small "seeds," as in an edible fig.

(4) "*Wild Tobacco*."—This is common up-country, on patanas, by roadsides, and in thickets and waste places generally and can be recognized by its very large, dense, erect terminal spikes of handsome white to pale purple flowers. It is not related in any way to the cultivated tobacco, *Nicotiana tabacum* and is actually a lobelia. It exists in two forms, to which the names *Lobelia nicotianaefolia* and *L. aromatica* are applied: they are closely similar and probably share the same properties. The plant was sent for identification in connection with a proposal to employ it as a termite eradicant. Its use as an insecticide is apparently fairly widespread here among vegetable growers to whom it is known either as "kiri-bamboo" (S.) or "poila-colla" (T.) Other names may also exist. The leaves are the part of the plant employed, and they are either boiled to give a decoction, or used freshly chopped as a bait against, *e.g.*, cut-worms. It may be significant that species of lobelia are known to contain the alkaloid lobeline, which resembles nicotine in its insecticidal properties.

T. R. I. Herbarium.—Ninety sheets were added to the general collection during the year, including 58 new species. The herbarium now contains 389 sheets of 258 species, representing 164 genera in 72 families of flowering plants. The genera have been arranged by families in the order that they occur in Trimen's "Handbook of the Flora of Ceylon."

We are indebted to the Botanist, Peradeniya, for thirteen identifications and for other information supplied during the year.

New Green Manure Species.—The eleven new leguminous species mentioned in the last Annual Report have again been grown, together with another *Tephrosia* species representing an earlier introduction from the same source. Notes on four of these species are given below, and are based on records obtained at St. Coombs and at the T. R. I. Sub-Station at Passara.

(1) *Tephrosia eriosemoides*.—This has a most desirable, compact, leafy habit and has made excellent growth at St. Coombs. It has not suffered any obvious damage from pests and diseases. The original planting, consisting of a bed about four feet square, flowered after sixteen months' growth, and yielded nearly two pounds of seed.

(2) *Tephrosia toxicaria*.—Rather more upright in habit than the above; this has continued to do well at St. Coombs, but so far has been very disappointing at Passara.

(3) *Crotalaria recta*.—This was noted last year as the most promising species after the two *Tephrosias*. For a *Crotalaria*, its habit and succulence of foliage are excellent, but it seems to be unusually susceptible to *Argina* caterpillars and other insect pests, and may have to be discarded on this account.

(4) *Sesbania cinerescens*.—This was not particularly favoured in the first season on account of its erect, rather spindly habit of growth. Subsequently, however, it was realized that this would be the chief value of the plant and would determine its use, not as a bush green manure, but as a form of low shade. At present, at nearly two years old, the plants on St. Coombs are 10-12 feet high. They branch from the first 3-4 feet or so, the branches gradually spreading out and bearing a relatively sparse cover of finely divided leaves throwing a light, feathery shade. This habit has resulted from growing a few plants close together in a clump un-

lopped: its response to wider planting distances, and to lopping, has not yet been investigated. Owing to its open habit and elastic stems, it should be very resistant to wind. On St. Coombs it has been relatively free from pests; at Passara, where a height of 5 feet was reached in 3 months, the *Albizzia* caterpillar, *Terias hecabe*, has been troublesome. This species, and *Tephrosia erioseoides*, are both strongly recommended for further trial by estates. Small packets of seed of all four species are available for distribution, and may be obtained from St. Coombs.

Mimosa bracaatinga.—This continues to grow well both at Passara and St. Coombs. A number of estates received sample packets of seed for trial during the year, and some seed is still available.

Albizzia sumatrana.—This is a new species of shade tree, apparently introduced from Java in 1940 and grown since then on several estates in the Central and Uva Provinces. In Java, it is stated to be liable to damage by wind, but with this exception to be suited to all elevations between 2-5,000 feet, and to produce a light, spreading shade without lopping. It is doing well at Passara, where the habit is excellent and growth has been rapid, a height of about 20 feet being reached in nineteen months. It has not so far made much growth on St. Coombs.

"Hard" Seeds.—Many samples of the seeds of leguminous plants normally contain a proportion of so-called "hard" seeds which, although fully viable, fail to germinate on account of their inability to absorb moisture. Thus, in thirteen batches of seed of the various introduced species mentioned in the foregoing paragraphs, and tested in the laboratory, the proportion of "hard" seeds varied from 4 per cent to 93 per cent, with an average of 58 per cent. "Hardness" refers entirely to the impermeability of the seed coat and "hard" seeds will germinate readily once this condition is broken down, so that the entry of water is permitted. There are several ways of doing this. The most certain is to "nick" the seeds or chip the seed coat with a needle or other instrument, and this is the procedure usually adopted in the laboratory. Obviously it is suitable only for small quantities at a time. Another way is by treating the seed in acid or in hot water, but this method needs careful control and is, besides, liable to damage those seeds in the sample which are not "hard." The simplest way, which is sufficiently reliable for practical purposes, and which should always be used when samples of seed are obtained for trial from this Institute, is to scarify the seed by shaking vigorously with sand. Small samples should be treated in a tin or bottle, larger quantities in a sack. The seed and sand should be mixed in roughly equal proportions and shaken together vigorously for about five minutes. A simple test of the effectiveness of the treatment can be made by leaving a few seeds for a day or two on wet blotting paper in a saucer and observing the proportion which becomes swollen and which will germinate without difficulty.

C. H. GADD.

Acting Plant Physiologist.

REPORT

OF

THE BIOCHEMICAL DEPARTMENT

FOR 1942

Captain J. Lamb was absent on military duty from the beginning of February when the Biochemical Department came under the immediate charge of the Director.

Mr. H. B. Sreerangachar, Research Assistant, was deputed to work at the laboratories of the Indian Institute of Science, Bangalore, for several months in connection with his researches on the mechanism of tea fermentation. Equipment not available in Ceylon was there at his disposal and he was able to make marked progress in elucidating the nature of the enzyme system. The thanks of the Institute are due to Sir J. C. Ghosh, Director of the Indian Institute of Science and Mr. M. Sreenivasaya for these facilities.

Mr. P. R. Perera, Assistant, was unfortunately away for a considerable period on sick leave.

The conditions prevailing in the tea market, whereby a large proportion of the crop was sold on contract at a pre-determined rate, had the not unexpected effect of reducing interest in manufacturing problems to a minimum and as a result enquiries on this subject were few in number.

It is to be feared that price stabilisation may lead to some deterioration in manufacturing conditions though fortunately the powers which the Tea Commissioner has to reduce the prices for teas found to be below standard quality may serve as a useful check on this tendency. It would be regrettable if present day conditions should lead to any falling-off in the standard of manufacture and thus retard the general improvement which has been noticeable in recent years up to the outbreak of the war.

BIOCHEMICAL.

Tea Fermentation.—Investigations into the mechanism of tea fermentation have made steady progress during the year under report.

For sometime past there has been a friendly argument between this laboratory and the investigators at Tocklai regarding the exact nature of the enzyme system concerned in tea fermentation. In order to round off some of the points of divergence a spectroscopic investigation was necessary and this has now been carried out by Mr. H. B. Sreerangachar at the Indian Institute of Science, Bangalore, where such facilities were available.

This investigation appears to confirm the previous work carried out at St. Coombs and no evidence was found of the presence of either Cytochrome or Cytochrome oxidase in tea. The position regarding the mechanism of fermentation has thus become much clearer.

A study of the chemical nature of the tea oxidising enzyme has shown that copper forms an essential constituent of the enzyme. Purely from other considerations, tea oxidase was till now grouped as a member of a family of enzymes known as polyphenol oxidases having similar properties. The present finding is in complete harmony with such a classification as it is well known that other members of this family also contain copper as their active group. In the light of these results there can be no reasonable doubt regarding the polyphenol oxidase nature of the tea enzyme.

The presence of copper in the enzyme may explain the role of this "minor" element in the tea plant. In view of the Nyasaland Researches (Nyasaland Tea Association Quart. J. (1937) 1, 8) the practical implications of the above finding are being explored.

Publications.—Four more papers in the series "Studies on the Fermentation of Ceylon Tea" have been communicated for publication in the Biochemical Journal.

1. Estimation of the Oxidising Enzyme Activity by H. B. Sreerangachar
2. Comparative Rates of Oxidation of Different Polyphenolic Substrates by Tea Oxidising Enzyme, by H. B. Sreerangachar.
3. The Nature of the Tea Oxidase System by H. B. Sreerangachar.
4. The Prosthetic Group of Tea Oxidase, by H. B. Sreerangachar.

MANUFACTURE.

Rolling Experiments.—40 experiments were done. This number includes 4 carried out in 1943 which have been added to complete the results.

The object of these experiments was to find the best procedure for expressing juice rapidly and obtaining even fermentation. Three methods were adopted and a comparison was made with teas rolled 5 times in the normal way — dhool out-turns 7 per cent, 10 per cent, 18 per cent, 25 per cent, 30 per cent and Big Bulk 10 per cent.

Series I.—The procedure adopted to obtain the maximum effect in minimum time (M) was first to roll the leaf in a Crescent roller for 30 minutes to give about 20 per cent dhool. The bulk was then passed through the Clivemeare roller at a pressure just sufficient to press the leaf without spoiling its appearance, and rolled in the Crescent roller for another 30 minutes with very heavy pressure. The big bulk was reduced to about 10 per cent.

Various degrees of wither for M were tried out. M. was preferred to the normal rolled teas (N) only when the wither was very soft (moisture content of 65 per cent.) There was very little difference in value but more brightness and character were reported by the tasters in the experimental samples.

Series II.—The leaf was rolled in the Crescent roller with heavy pressure for 60 minutes to obtain 50 per cent dhool. The 2nd roll was done in a M. S. roller in order to bring the bulk to about 10 per cent. The two dhools were then passed through the Clivemeare roller at very light pressure and rerolled on a plain table with a smooth cone.

As in Series I the experimental samples were given very slight preference over normal manufacture only when the wither used was very soft.

It is proposed to repeat these experiments.

Series III.—A 3-roll programme was adopted, the dhool out-turns being 20 per cent, 30 per cent, 40 per cent and 10 per cent for big bulk. Period of fermentation was the same as for the 5-roll programme. Rollers fitted with Lamont-Michie and Crescent battens were used for the first rolls and M. S. for the last.

Each experimental sample was taken from the bulk of 4 days' manufacture so that errors due to charging intervals and battens were eliminated. The experiment was spread over all seasons and represents 72 days' manufacture.

The tasters' reports on these teas may be summarised as follows:—

Dry weather season:— Practically no difference between the 3-rolls and 5-rolls.
(February-March)

Inter-Monsoon season:— 5-rolls slightly preferred on account of more brightness and more character. Very little difference in value. 3-rolls slightly stronger and more coloury.
(April-May)

S. W. Monsoon season:— B.O.P's and F.P's — practically no difference in value between 3-rolls and 5-rolls. Fannings of 3-rolls slightly preferred.
(June-August)

Inter-Monsoon season:— 5-rolls preferred. 5-rolls possess desirable characteristics of tea to a slightly higher degree than 3-rolls. Not a great difference in value.
(October-November)

N. E. Monsoon season:— 5-rolls preferred. Little more point and quality in the cup than 3-rolls.
(December)

5-rolls given preference on 13 occasions.

3-rolls given preference on 5 occasions.

It should be noted that the degree of wither was the same for both sets (Average of 55 per cent moisture content in the withered leaf). It is now proposed to attempt improvement for the 3-roll programme by varying the wither and fermentation.

Firing Experiments.—Experiments were conducted in the past on firing to different levels of moisture content, but the effects of very long periods of storage were not observed. It was considered possible that a very low moisture level would bring about the complete inactivation of the enzymes and that tea packed under such conditions might keep better than tea packed with a higher moisture content.

The experiments were accordingly repeated and samples were sent to America. Duplicates were retained in Colombo until the approximate date of tasting in Boston. The samples for Colombo were packed in bottles with waxed corks and those for America in tins with well fitting lids. Details of the samples are as follows:—

High moisture content—	fired to 4—5% and packed at	4.5—5.5%
Medium moisture content—	fired to 3% and packed at	3.5—4.0%
Low moisture content—	fired to 2—3% and packed at	3%
Very low moisture content—	fired to 1—2% and packed at	2.5—3.0%

The samples in Colombo were tasted after about 7 months' storage and were reported on as having kept remarkably well. The teas had generally retained their true characteristics but those packed at the extreme levels had tended towards a loss of colour and a somewhat bitter taste. Medium and low fired teas gave the best results, the latter having been slightly preferred. No reports have yet been received on the teas sent to America.

PACKING MATERIALS.

(a) *Linings*.—Two types of paper linings were tested. One was a grease-proof paper and the other, "T line," was a type of double Kraft with an adhesive resembling Bitumen between.

The former gave no indications whatever that it would be suitable for the packing of tea but the latter appeared promising. In strength, the latter paper compared very favourably with aluminium and lead foil but had a tendency to puncture. So far as resistance to moisture was concerned it was only slightly inferior to metal foils.

(b) *Tea Chests from Local Woods*.—A miniature chest made from *Grevillea* was tested. No unfavourable comments were made on teas stored in this chest.

Fuel Tests.—Different lengths of firewood were compared. The procedure was the same as that followed for the comparison of different fuels except that the temperature of the air flowing from the heater was maintained at 185°F (*vide Tea Quarterly* Vol. IX, p. 166).

The tests were carried out with fairly wet firewood (37 per cent moisture). The mean weight of a cubic yard was 850 lb. On the basis that the fuel cost Rs. 4.00 per yard, the tests revealed the following costs:—

(a) Cost of fuel per cubic yard.	9 ins. cents	12 ins. cents	18 ins. cents	36 ins. cents
Cutting with circular saw @ 8 cts. per hour	8	6	4	—
Splitting @ 8 cts. per hour	20	22	26	28
Total cost	428	428	430	428
(b) Cost of fuel per pound	50	50	51	50
(c) Lighting up drier to 185°F.	mins.	mins.	mins.	mins.
Time taken	110	115	130	130
Weight of fuel used	lbs.	lbs.	lbs.	lbs.
	275	290	325	325
Cost	cents	cents	cents	cents
	138	145	166	163
(d) Maintenance of temperature per hour from end of lighting up time:				
Air intake	76°F	77°F	78°F	76°F
Inlet temperature	184°F	184°F	184°F	186°F
	lbs.	lbs.	lbs.	lbs.
Weight of fuel	129	135	135	125
	cents	cents	cents	cents
Cost	65	68	69	63

These tests were done in very dry weather. No difficulty was experienced in maintaining a level fire with the bigger lengths in view of the fact that the firewood was well split. It is hoped to carry out further tests during the South-West monsoon on greener fuel and unsplit wood.

Individual Bush Manufacture.—Leaf from clone 9 was manufactured and was found to possess the same characteristics as those of the parent bush which is a non-fermenter.

Leaf harvested from selected bushes of a low-country estate was also manufactured on several occasions.

Miscellaneous.—Routine examinations were carried out on 967 samples of St. Coombs tea and 69 samples from other estates.

Estimations of prussic acid in fresh and dried manioc samples were made on several occasions and preliminary experiments carried out on the drying of manioc on a commercial scale.

At the request of the military authorities a simple method of dyeing cotton materials, mosquito nets, etc. was worked out in which waste tea was the basic material. This proved effective for the particular purpose for which it was required.

ROLAND V. NORRIS,
Director

REPORT

OF THE

THE SMALL-HOLDINGS OFFICER,

BADDEGAMA, FOR 1942

Special Assessment.—As a result of representations made by the Institute, the 1941 competitors were allowed the concession of a special assessment by the Tea Controller. Several of them remitted the fee asked for, and a Special Assessor was appointed by the Tea Controller to re-assess their holdings. Before the re-assessment could take place, however, the coupon system was suspended, and the fees remitted were returned to the small-holders concerned.

Visit to Institute.—Three small-holders visited St. Coombs during January, and were shown round the laboratories and the field experimental plots. The small-holders concerned were the first prize winners in the 1939, 1940 and 1941 tea small-holdings competitions.

1942 Competition.—Early in the year, those who joined in this competition were taken in batches to the 1941 Prize Holdings and demonstrations and instruction classes held there. The amount of progressive works carried out in these holdings was quite a revelation to these competitors.

The preliminary judging of this competition was carried out during November, and it was found that the progress made by these competitors was insufficient. Conditions arising out of the war had interfered with the carrying out of the necessary progressive works. It was therefore decided to give them more time, and the final judging was postponed for 1943.

Advisory Work.—Travelling in connection with advisory work was arranged so as to economise petrol consumption as far as possible. The petrol ration allowed did not permit of the extension of advisory work to new areas. Work had perforce to be confined to the competition areas. This had the advantage of helping to consolidate the work already carried out in these areas.

Advisory visits were as follows:—

First visits to small-holdings	...	6
Revisits to small-holdings	...	926
First visits and revisits to small estates		36
Total visits		968

Vegetative Propagation of Tea.—This was demonstrated at all instruction classes. It was successfully carried out in SK, 3,143, one of the 1941 prize holdings.

Tea Manufacture.—SK. 4,564, one of the 1941 competitors, began to manufacture tea during the year and was given necessary advice. A new factory was opened in the Yakkallamulla area. This should enable the small-holders of Kottawa and Walawe Palatas to dispose of their green leaf more readily. There are now two factories serving this area, and the small-holders' needs are fully met.

Pruning.—On 29.4.41 cut-across demonstrations were carried out on SK. 2,845, the holding that won the first prize in the 1940 tea small-holdings competition. The owner himself then took up the pruning and, adhering strictly to the demonstration bushes, completed the work by 10.5.41. This was the first time this small-holder had done any pruning. In December, 1942, the holding was still being plucked. Careful pruning and plucking, regular cultivation and application of compost had all helped to obtain this result.

Food Production.—Nearly every small-holder was engaged in food production work. Some of them had put to good use the methods of soil conservation learnt while participating in the tea small-holdings competitions. Leaflets received from the Agricultural Department were explained to them. Two public meetings in connection with the food drive were attended.

Tea Coupons.—With the steady decline of the value of tea coupons their suspension was not altogether unexpected. When the suspension did come, small-holders accepted it more or less philosophically. It did, however, compel them to pay some attention to their holdings, which, in many cases, had been abandoned for years.

Maximum Price for Green Leaf.—The stabilization of the green leaf market has come as a much needed relief to small-holders. They are now assured of a fair and reasonable price for their green leaf. Already there are signs of abandoned holdings being brought into plucking. The Tea Controller's notices, pertaining to green leaf, have been explained to small-holders in the working areas.

Village Committees.—The Wanduramba Village Committee has once again contributed a portion of the prize money for the 1942 competition. This Committee's sustained interest in the work of the Institute is greatly appreciated. Mr. W. Amerasinghe, who has been of great assistance in the past, is once more Chairman of this Committee.

Chief Headmen.—The Mudaliyars of Gangabodde Pattu and Talpe Pattu have continued to back up the Institute's activities. As in previous years, the Chief Clerk of the Office of the Mudaliyar of Gangabodde Pattu, has given much assistance. Their co-operation is gratefully acknowledged.

Instructional Leaflets.—Sinhalese translations of the speeches made by members of the Senior Staff of the Institute, at the 1939 and 1940 prize givings, have been sent to small-holders in all Chief Headmen's Divisions.

Office.—25 small-holders visited the office and obtained necessary advice. 58 letters were received and 210 sent out.

Quarters.—No change.

F. D. TILLEKERATNE,

Small-Holdings Officer,

REPORT

OF THE

THE SMALL-HOLDINGS OFFICER, ARAMBEGAMA, FOR 1942

The writer assumed duties on 15th July, 1942, to act for Mr. R. L. Illankoon on permanent military duty.

The weather during this period was wet. The majority of the small-holdings in the area being worked were in a poor state owing to the operation of the tea coupon system. This system which had caused much harm was withdrawn later in the year. Most of the small-holdings were covered with high weed and the owners had to spend much money and labour to bring them back to their former state. Owing to the causes stated above the main work was confined to that of an advisory nature. Instructions were given on soil conservation, pruning, weeding, manuring, drainage and cultivation. 250 small-holdings were visited.

A meeting of small-holders, also attended by planters, factory owners and bought-leaf suppliers, was held at Wattapola presided over by Mr. T. B. Panabokke, Adigar. The main objective of this meeting was to impress on the small-holders the need to produce a better type of leaf which would find a ready market and the general improvement of small-holdings. A number of meetings organized by the Local Assistance and Village Committees and Food shows were also attended and talks were given at some of them. Demonstrations in lung pruning, tipping, plucking and drainage (Reverse-slope) were given at different centres.

There was a general increase in the price of green leaf which proved an incentive to the small-holders to appreciate the advice given to improve their holdings. Better results will be shown in the coming year.

It was observed that there is a tendency among some bought-leaf factory owners to purchase at a lower rate leaf rejected by other factories who adhere to a finer type of leaf. It is suggested that some method be adopted so that all factory owners should purchase a finer type of leaf. This method would encourage all small-holders to produce a better type of leaf, thus improving the industry.

The Ratamahatmayas, the Divisional Revenue Officers, Minor Headmen, Local Assistance and Village Committees continued to give their help and co-operation which are gratefully acknowledged. Mention must also be made of the assistance rendered by the Divisional Inspector of Schools for the use of school buildings to hold meetings.

M. B. BOANGE,

Small-Holdings Officer.

The Tea Research Institute of Ceylon.

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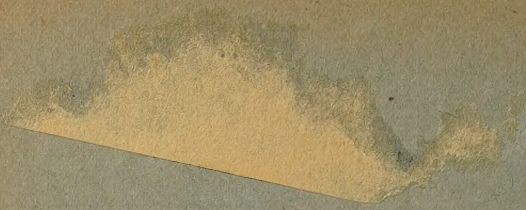
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